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On the genus Eriogynia.

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(WITH PLATE XIV.)

The discovery of a remarkable rosaceous plant, totally unlike in appearance all ordinary species of *Spiræa*, and yet in its flowers and fruit very close to another peculiar western species, the *Spiræa cæspitosa* of Nuttall, has led me to an examination of the entire group of allied species, the results of which are here given.

The new species was discovered by Rev. F. D. Kelsey on July 4, 1888, growing in large dense cushion-like masses high up on the precipitous cliffs overhanging the Missouri river at "The Gate of the Mountains," near Townsend, Montana. It sends its long roots deep into the crevices of the rocks, while the slender woody branches, many times subdivided, are crowded together and densely covered with the long-persistent imbricated leaves, which are only one or two lines long. Only the outer leaves of the mass remain green, the lower soon becoming a light rusty brown. The flowers are wholly concealed, hidden away within the clump and solitary on the ends of the branches, but often appearing lateral from the prolongation of a side shoot. The very short pedicel does not raise the flower above the leaves that surround it. The characters of the flower and fruit are so well given in the accompanying figure as to need no farther description.

For comparison Mr. Faxon has added a figure of *Spiræa cæspitosa*, which has the same habit of growth, forming dense mats on the surface of rocks, with the similar but much larger leaves in rosettes, the flowers in close racemes upon bracteate terminal peduncles. This species formed the section *Petrophytum* of Nuttall, as published in Torrey and Gray's Flora, to which Maximowicz has also referred a shrubby Mexican species, *S. parvifolia*, Benth., that belongs, however, rather in another section (*Holodiscus*) with *S. dumosa*.

Still another dwarf suffrutescent species is the *S. pectinata* of Torrey and Gray, upon which Hooker based the genus *Eriogynia*, and which is also represented on the plate.

The habit here is much the same, though less densely cespitose, and the palmately divided and nerved leaves are more scattered. The flower and fruit show other differences of more or less importance. The margin of the disk that lines the calyx-tube is more thickened and crenately lobed, and outside this margin, as in the other species, are inserted the distinct stamens approximately in one row, of which those opposite to the middle of the sepals are filiform to the base. The seeds have a loose testa much longer than the embryo, similar to those found in *Sorbaria* (*Spiræa sorbifolia*, etc.).

Unlike as these species are, yet they are more nearly related to each other than either of them is to any other species that has ever been included in *Spiræa*. If *Eriogynia pectinata* is rightly separated from *Spiræa*, as I think, then *S. cæspitosa* should rather be joined with it than retained in *Spiræa*, and with it should go our new species, which I have accordingly named *E. uniflora*. The marked differences between these species, so marked that some would probably consider them generic, justify the designation of three sections, *Eriogynia* proper, *Petrophytum*, and *Kelseya* for *E. pectinata*, *E. cæspitosa* and *E. uniflora* respectively, the distinguishing characters of which are obvious.

Cambridge, Mass.

Contributions to the knowledge of North American Sphagna. IV.

C. WARNSTORF.

VI. Sphagna subsecunda.

A. *Leaves on both sides entirely without pores; rarely on the outer side with appearances of resorption, here and there, between the very strong and prominent fibril-bands, in the apical half of the leaf. Chlorophyllose cells in cross section broad-rectangular to broad parallel-trapeziform, with very thick walls, especially on the free-lying outer side, the lumen small, roundish-oval. Stem nearly branchless or with 1 or 2 (very seldom 3) uniform branchlets; isophyllous, the stem leaves very slightly larger.*

24. *S. Pylaiei* Brid. Bryol. Univ. 1. Suppl. p. 749 (1827).

Syn.: *S. sedoides* Brid. Bryol. Univ. 1. Suppl. p. 750 (1827).
Hemitheca Pylaiei Lindb. MSS. 1879.

Newfoundland (*de la Pylaie*); New York (*Peck*); New Hampshire (*James*); New Jersey (*Austin*); Carolina (*Sullivant*); Miquelon Island (*Delamare*).

Var. **ramosum** WARNST. in Samml. Europ. Torfm. Serie I, no. 98 (1888). Stem with 1 or 2 (rarely 3) branchlets in a fascicle, pendent branches wanting.

f. *nigricans* BRID. Tufts above black or blackish brown, below brown or more or less blanched.

Miquelon Island (*Delamare*): N. Hampshire, Mt. Willey, 2,500 ft. (*Faxon*).

f. **versicolor** WARNST. Tufts above and in the middle part green and brown or blackish spotted.

N. Hampshire, Mt. Willey, 2,500 ft. (*Faxon*).

f. **ferruginea** WARNST. Plants above red- or dirty-brown, below more or less blanched.

N. Hampshire, Mt. Willey, 2,500 ft. (*Faxon*).

Var. *scdoides* (BRID.) LINDB. Stem nearly or quite simple, without branches. This form I have not yet seen from N. America, but only from France (*Finistere*), collected by Dr. Casnus and de la Pylaie in Herb. Bridel.

Lindberg, in Hvitmossor (1882), refers S. Pylaiei, and with it *S. cyclophyllum* Sull. and Lesq., to a separate group, HEMITHECA, because both species are furnished with a semiglobose capsule. S. Fitzgeraldi also has a similar hemispherical fruit, but it nevertheless belongs to the CUSPIDATUM group. It seems to me that it is improper to found groups on the form of the sporogonium, especially in the Sphagna, because usually in the most widely different divisions it has the same form and exhibits no anatomical distinctions. According to Limpricht (Kryptogamenfl. von Deutschl. Bd. IV, p. 135) the capsule of S. Pylaiei is *destitute of stomata*. As it appears however that this species very rarely fruits, I think that even this peculiarity in the structure of the capsule is not competent to serve as a group character. In habit, form of leaves and the position of the chlorophyllose cells, this species agrees quite well with the SUBSECUNDA; wherefore I place it, as also S. cyclophyllum, in that group. I have seen neither fruits nor male plants of S. Pylaiei.

B. *Branch leaves always porose. Fibril-bands with a meniscoid projection inward. Chlorophyllose cells in cross section narrow-rectangular to narrow-trapezoidal or nearly tunshaped, free on both sides and only on the two external walls somewhat thickened, lumen longish-elliptical. Stem either nearly branchless or with 3 to 5 dimorphous branchlets in a fascicle.*

a. Stem cortex formed of two or more layers of cells.

a. Stem leaves very large, broad roundish-oval, throughout furnished with fibrils, which in the parts near the chlorophyllose cells are regularly connected by cross fibrils; within the latter, on the outside of the leaf, lie numerous pores in rows, like strings of pearls. Stem usually quite simple, rarely with single branchlets.

25. *S. cyclophyllum* SULL. AND LESQ. in Musc. Bor.-Am. 1 ed. (1856).

Syn.: *S. obtusifolium δ. turgidum* Hook. in Drumm. Musc. Am. 2d Coll. No. 17 (1841).

S. Caldense β. scorpioides Hpe. (Glazion n. 7042) in Herb. Copenh.

S. laricinum var. *cyclophyllum* Lindb. in Act. Soc. Sc. Fenn. 10, p. 280 in add. (1872).

S. Drummondii Wils. MSS. Braithw. II. cc. as synon.

Hemitheca cyclophylla Lindb. MSS. 1882.

New Orleans (*Drummond*); Alabama (*Lesquereux*); N. Jersey (*Austin*).

Cardot, in Rév. des Sphaignes de l' Amérique du Nord (1887), p. 12–13, considers this species as an incompletely developed form of S. subsecundum. There is indeed no doubt that the thick branchless stem structure of this species gives the impression that it may be a young plant of some subsecundum form; but the almost regular linking of the fibril-bands by the cross-fibres, between which on the outer surface lie the numerous strong-ringed pores in pearl-string rows, at once gives to the cell network, under the microscope, a remarkable appearance, not repeated in any other species of the subsecundum group yet known to me, although I have already examined about forty, in part published, in part new exotic species, of this the most difficult of all the Sphagnum groups.

With respect to habit as well as to the form of leaf S. cyclophyllum stands, at all events, the nearest to *S. Caldense* C. Müll. (Bot. Zeit. 1862); the latter however has very few pores on either side of the leaves, and on both sides the pores usually stand singly in the apical half of the leaf, especially in the angles of the cells, or even several near each other on the outer side: the stem cortex I have found to be formed of one stratum of cells, whereas in S. cyclophyllum it is irregularly formed of several strata. For these reasons I must pronounce S. cyclophyllum a good characteristic species of the SUBSECUNDUM group, but which by no means deserves to be considered the type of a separate group (HEMITHECA Lindb.).

β. Stem leaves large, in form and areolation quite similar to the branch leaves, fibrillose quite to the base and narrowly bordered. Fibrils on both sides of the leaf at the base not united by cross-fibrils; pores in the upper half of the leaf on the outer surface extremely small, close to the commissures.

26. *S. platyphyllum* (Sull., Lindb.) Warnst. in Flora, 1884.

Syn.: *S. neglectum* Aongstr. (1864), Aust. Musc. Appal. n. 26, 1870.

S. subsecundum β. *isophyllum* Russ. Beitr. p. 73 (1865).

S. platyphyllum, nov. sp.? vel var. *S. neglecti?* Sull. MSS. 1868.

S. laricinum γ. *platyphyllum* (Sull.) Lindb. Notiser, Heft. 13, p. 403 (1874).

By Cardot, in Rév. des. Sphaignes de l' Amérique du Nord, p. 13, this species is attributed to New Jersey.

Massachusetts, Boston, 75 ft. (*Faxon*), Essex Co., 75 ft. (*Robinson*).

This species, with respect to its stem leaves, stands in the same relation to *S. contortum* Schultz (*S. laricinum* Spruce) as S. rufescens and S. obesum do to S. subsecundum. The specimens of S. platyphyllum from N. America examined by me agree in all points with the European plant. Hitherto I have seen no male plants except those collected by Dr. Beckmann at Bassum in Hannover (Germany); the fruit is yet unknown.

γ. Stem leaves small, linguiform, with a border widened downward. Hyaline cells fibrillose only near the apex of the leaf; always well differentiated from the branch leaves. Pores on the outer surface of the branch leaves in the apical part extremely small, isolated, or several in interrupted rows on the commissures.

27. *S. contortum* Schultz in Prodr. Fl. Starg., Suppl. no. 93 (1819).

Syn.: *S. laricinum* Spruce, MS. 1847.

S. contortum δ. *laricinum* Wils. Bryol. Brit. p. 23 (1855).

S. cavifolium Warnst., var. 2 *laricinum* (Spruce) Europ. Torfm. p. 86 (1881).

Ohio; New Jersey; New York; Massachusetts, Essex Co., 75 ft. (*Robinson*).

In Hedwigia, 1888, pp. 266 and 267, I expressed the opinion that the true S. contortum of Schultz had been hitherto by most bryologists erroneously placed among the forms of S. subsecundum. But since Limpricht and I have had the

opportunity to examine several original specimens (such I have had before me in Herb. Bridel and in Funck, Deutschlands Moose) it is unquestionable that Schultz's moss is identical with S. laricinum Spruce, therefore the latter must hereafter bear the name S. contortum. Whether the var. Floridanum Ren. et Card. in Rev. Bryol. 1885, p. 46, belongs to S. laricinum or to S. platyphyllum I can not decide for lack of authentic specimens.

b. Stem cortex formed of a single stratum of cells, rarely with isolated cells divided by a longitudinal wall.

α. Stem leaves small to medium-sized, with a border more or less widened downward; hyaline cells near the apex fibrillose. Inner pores of the branch leaves scanty, especially in the upper and lower angles of the cells. Outer pores very numerous on nearly the whole surface of the leaf, at the commissures in rows like strings of pearls.

28. *S. subsecundum* NEES in Sturm, Deutschl. Flora 2, fasc. 17 (1819).

Syn.: *S. contortum* var. *subsecundum* Wils. Bryol. Brit. p. 22 (1855).

S. Lescurii Sull. Moss. U. S. p. 11 (1856).

S. subsecundum α. heterophyllum Russ. Beitr. p. 72 (1865).

S. cavifolium var. 1. *subsecundum* Warnst. Europ. Torfm. p. 81 (1881).

Probably as abundant in the northern parts of North America as it is in Europe and in numerous forms.

New Hampshire, Crawford House, 1,900 ft., Franconia, 1,000 to 2,000 ft.; Mass., Boston, 75 ft., Brookline and Dedham, 75 ft., Bedford, 100 ft. (*Faxon*).

The var *pseudo-molle* Ren. et Card. Rev. Bryol. 1885, p. 45, from Florida according to Cardot in Rév. des Sphaignes p. 12, is unknown to me; he ascribes to it great softness and the habit of S. molle and remarks that the stem cortex is wanting or indistinct.

β. Stem leaves large, oval-linguiform, the lateral margins narrowly and uniformly bordered down to the base; hyaline cells fibrillose from the apex far downward, often quite to the base, and with small pores on both sides. Branch leaves large, *on the inner side with numerous small pores, in the vicinity of the margins sometimes in rows, on the outer side still more numerous, in rows like strings of pearls, on the commissures.*

29. *S. rufescens* BRYOL. GERM. p. 15, tab. II, fig. 6* (1823), Limpr.

Syn.: *S. contortum* Nees, Schpr., Lindb. and others.

Massachusetts, Boston 100 ft. (*Faxon*).

This species, which is sometimes as tall and stout as the following, is distinguished from the genuine S. subsecundum as well as from S. obesum, by the pore structure of the branch leaves. The pores are always numerous on both sides (although less so on the inner) and are small with strong rings. The color of the tufts is sometimes grass- or gray-green, sometimes brownish red or dappled with green and red. The plant is a water-lover, but also occurs in drier situations; it is seldom found completely submersed and floating in water like the following species.

γ. Stem leaves in form and cell-structure like the preceding but with fewer pores on both sides. Hyaline cells, as a rule, fibrillose quite to the base. Branch leaves large, either with few pores on both sides, or on the outer side with somewhat more numerous pores in nearly all the cell-angles, but never in uninterrupted rows as in the preceding species.

30. *S. obesum* WILS. Bryol. Brit. p. 22 (1855).

Syn.: *S. subsecundum* var. *turgidum* C. Müll. Synops. I, p. 101 (1849)?
S. turgidum (C. Müll.) Röll, Flora, 1886?
S. decipiens Sull. et Lesq. in Herb. Kew.

Virginia (*Lesquereux*); New Hampshire, Crawford House, 1,900 ft.; Mass., Lynn, 50 ft., Boston, 50 ft. (*Faxon*).

This is a truly aquatic plant; it is usually found quite submersed and floating. Its color is, like that of the preceding species, extremely variable, sometimes grayish green, sometimes dark brownish-red, sometimes variegated. It generally assumes a plumose habit similar to that of certain aquatic forms of the CUSPIDATA. It may always be with certainty distinguished from the forms of the preceding species, which it often closely resembles in habit, by the much scantier pores in the branch leaves, which, even if more numerous on the outer side, never occur in uninterrupted rows like strings of pearls, but only more plentifully distributed in the angles of the cells.

Standing the nearest to Sph. obesum in habit is a species very recently distinguished by me, *Sph. crassicladum*, from England (Bot. Centralblatt, 1889, no. 45). The branch leaves are very large, broad roundish-ovate to longish-ovate, nearly flat, with margins not involute; the apex broadly truncate and 7 to 9-toothed; the border 3 to 5 cell-rows wide. When dry the leaves are slightly glossy and the margins feebly undulate. The hyaline cells are furnished with numerous inwardly meniscoid-projecting fibril-bands, and the fibrils in the upper two-thirds to three-fourths of the leaf on

the inner side are connected with each other by cross-fibrils which enclose rows of small pores. On the outer side in the apical part of the leaf the fibrils are partially connected by delicate, often incomplete, cross-fibrils which only rarely enclose one pore, therefore, here especially, the pores only occur in the upper, or sometimes in the upper and lower angles of the cells; in the basal half of the leaf near the margins the pores are more numerous, sometimes in interrupted rows on the commissures. The pore distribution however is always the reverse of that of S. rufescens, since *the pores are the most numerous on the inner side of the leaf*.

This species must certainly be found also in North America, wherefore I have taken the liberty to draw attention to it.

According to my observations hitherto I conclude that, in the SUBSECUNDUM group, so far as the European and North American species are concerned, the number and distribution of the pores on the two surfaces of the leaf must be considered of the highest importance, and deserve to be taken into account in distinguishing the several types. But this is only possible when we employ, in the investigation of the various forms, the staining process. We shall then find that the pores occur—either very abundantly only on the outer side and very scantily on the inner side (S. subsecundum and S. cyclophyllum),—or conversely they are more numerous on the inner side than on the outer (S. crassicladum),—or on both sides numerous (S. rufescens),—or on both inner and outer scarcer (S. obesum),—or on both sides (the membrane-gaps which sometimes occur on the outside being left out of the account) without pores (S. Pylaiei).

VII. Sphagna cymbifolia.

a. Transverse walls of the cortical cells of the branches saccately curved downward, so that the cells appear set into each other like a nest of boxes, therefore the branch cortex in cross-section (the downwardly curved transverse walls being frequently cut through also) often seems to be composed of three layers of cells. Hyaline cells of the branch leaves twice as wide as in the next group; chlorophyllose cells in cross section equilateral- to isosceles-triangular, inserted between the hyaline on the inner side of the leaf and here free, on the outer side entirely included. Hyaline cells at the base of the leaf, so far as they are united to the chlorophyllose cells, furnished internally with comb-fibrils.

31. *S. Portoricense* HAMPE in Linnæa, 25, p. 359 (1852).

Syn.: *S. Sullivantianum* Aust. in Am. Jour. Sc. and Arts, 1863, p. 252. *S. Herminieri* Schpr.

N. Jersey (*Austin, Rau*); Florida; Louisiana, according to Cardot in Rév. des Sphaignes de l' Amérique du Nord.

In Hedwigia, 1889, p. 303–308, I attempted to show that this species, on account of its anatomical structure, should be placed among the forms of *S. imbricatum* (Hornsch.) Russ.= *S. Austini* Sull. But I did not then in my investigations take into consideration the structure of the cortex of the branches wherein the two species differ from each other, so now I do not hesitate to accord to S Portoricense its right to the rank of a distinct species, by reason of the peculiar saccately curved transverse walls of the cortical cells of its branches, such as I have observed in no other exotic species of the CYMBIFOLIA.

b. Transverse walls of the cortical cells of the branches not bent downward but level, the cells much narrower than in the preceding; the hyaline cells of the branch leaves usually only half as wide. Chlorophyllose cells in cross section usually equilateral-triangular, placed on the inner side between the hyaline cells, on the outside completely enclosed. The hyaline cells within, so far as they are united to the green cells, usually furnished with comb-fibrils, which occur sometimes abundantly, sometimes only scantily near the base of the leaf, and sometimes, though rarely, are entirely wanting.

32. *S. imbricatum* (HORNSCH.) RUSS. Beitr., p. 21 (1865).

Syn.: *S. Austini* Sull. in Aust. Musc. Appal. p. 3 (1872).

New Jersey (*Austin*); Miquelon Island (*Delamare*); Louisiana and Mississippi (*Langlois*); Newfoundland; Massachusetts.

This species, like S. cymbifolium, is very inconstant in habit, and also undergoes many variations with respect to color. The characteristic comb-fibrils within the hyaline cells of the branch leaves are sometimes very numerous and well developed, sometimes they appear only near the base of the leaf with more or less distinctness, and indeed may be sometimes entirely wanting. The knowledge of these facts I have gained from the abundant material, for which I am indebted to the kindness of Mr. Faxon. The plants collected by him in the vicinity of Boston, Mass., show these relative characters with a clearness that leaves nothing to be desired. In the same manner I have also learned that the *S. affine* Ren. et Card., in Rev. Bryol., 1855, p. 44, from the state of New York, is to be considered as only a form of S.

imbricatum without comb-fibrils, which frequently has squarrose branch leaves. The plant from Florida, with chlorophyllose cells, broad-trapeziform in cross section and free on both sides, provisionally I can not include here. In an article, "Welche Stellung in der Cymbifoliumgruppe nimmt das S. affine ein?" (Hedwigia, 1889, pp. 367–372), I have expressed my opinion at length, and therein stated that with regard to the occurrence of comb-fibrils in S. imbricatum three principal forms may be distinguished:

1. Var. *cristatum* with numerous comb-fibrils occurring in the lower half of the branch leaves.

2. Var. *sublæve* with slender beginnings of comb-fibrils in the hyaline cells near the base of the leaf, and

3. Var. *affine* (Ren. et Card.) entirely free from comb-fibrils.

Each of these three forms Mr. Faxon has collected near Boston, and has communicated to me in numerous and beautiful specimens, and also all three with distinctly squarrose leaves, so that there is of each variety a f. *squarrosula*. European specimens of these squarrose-leaved forms are not yet known to me nor those in whose leaves the comb-fibrils are entirely wanting, and which would correspond to the var. affine. These squarrose-leaved forms of S. imbricatum are analogous to *S. cymbifolium* var. *squarrosulum*, Bryol. Germ. (1823)=*S. glaucum* v. Klinggr. (1880).

c. Transverse walls of the cortical cells of the branches as in **b.** Chlorophyllose cells of the branch leaves in cross section narrow isosceles-triangular to triangular-elliptic or isosceles-trapeziform, placed on the inner side of the leaf between the hyaline cells and here always free, on the outside enclosed or with free outer walls. Hyaline cells internally, so far as they are united to the chlorophyllose cells, either quite smooth or faintly to strongly papillose. Stem cortex with abundant fibrils and usually with numerous pores in the external walls.

33. *S. cymbifolium* Ehrh. Hannov. Mag. 1780, p. 235.

Syn.: *S. obtusifolium* Ehrh. Pl. Crypt. no. 241 (1793).
S. latifolium Hedw. Sp. Musc. p. 27 (1801).
S. oblongum P. B. Prodr. p. 88 (1805).
S. crassisetum Brid. Sp. Musc. I. p. 15 (1806).
S. pseudo-cymbifolium C. Müll. Linnæa. 1874, p. 547.
S. subbicolor Hampe in Flora 1888, p. 400.
S. australe Schpr. Original in Herb. Bescherelle.
S. Whiteleggei C. Müll. Flora 1887, p. 408.
S. Cionotum C. Müll. Flora 1887, p. 408.

In North America as common as in Europe.

According to the development of the papillæ in the branch leaves I distinguish:

Var. **læve** WARNST. with perfectly smooth inner walls of the hyaline cells; here belongs also

f. *glaucescens* s. f. *squarrosula* (BRYOL. GERM.).

Plants usually blue-green; branch leaves with squarrose-spreading tips. This plant is the *S. glaucum* v. Klinggr. (1872).

Massachusetts, Brookline, 75 ft. (*Faxon*).

Var. *sublæve* LIMPR., with very indistinct papillæ on the internal walls of the hyaline cells, in part wholly wanting.

Of this variety I have hitherto seen no North American specimens.

Var. *papillosum* (LINDB.) SCHPR. Synops. Ed. II, p. 848 (1876).

Syn.: *S. papillosum* Lindb. in Act. Soc. Sc. Fenn. 10, p. 280 (1872).

Hyaline cells within, so far as they are united to the chlorophyllose cells, thickly and distinctly papillose.

Canada; Miquelon Island; New Jersey; Pennsylvania; New Hamsphire, Crawford's, 1,900 ft., Mt. Willey, 2,500 ft., Mt. Cannon, 2,500 ft.; Mass., Brookline, 75 ft. (*Faxon*).

With respect to the development of the papillæ in S. papillosum the case is exactly the same as in other species; sometimes these incrassations are extremely numerous, sometimes they almost disappear, and sometimes they occur very unequally on the same plant; so it is in S. Wulfianum, S. teres, S. squarrosum and in various exotic species of the RIGIDUM group. I can therefore see in *S. papillosum* Lindb. only the papillose form of S. cymbifolium, and can not even concede to it the rank of a subspecies. There is here a quite similar condition, with regard to the development of the papillæ, to that which exists in S. imbricatum with regard to the comb-fibrils.

In Rév. des Sphaignes, p. 4, Cardot, under S. cymbifolium, adduces a var. *Ludovicianum* Ren. et Card. from Louisiana and Mississippi, in which the cortex of stem and branches is scantily furnished with fibrils and whose stem-leaves are dimorphous. I have not seen it and therefore can not make any comments on it.

d. Transverse walls of the cortical cells of the branches the same as in **b** and **c**. Chlorophyllose cells in cross section elliptic, central and on both sides enclosed by the hyaline cells. Wood cylinder

dark red: stem cortex with few fibrils, sometimes almost free from them, and with few pores in the external walls. Inner walls of the hyaline cells, so far as they are united to the green cells, smooth or papillose.

34. *S. medium* LIMPR. Bot. Centralbl. 1881, p. 313.

Syn.: *S. cymbifolium*, var. *congestum* Schpr. Entw.-Gesch. d. Torfm. p. 69 (1858).

S. cymbifolium, var. *purpurascens* et var. *compactum*, Russ. Beitr. p. 80 (1865).

S. Andinum Hampe in Ann. Sc. Ser. 5, 1866, p. 334.

S. arboreum Schpr. in Herb. Kew. (Peru).

S. ovatum Schpr. in Herb. Kew.

S. crassum C. Müll. in Herb. Rom.

S. bicolor Besch. in Bull. de la Soc. Bot. de France, p. lxviii (1855).

S. cymbifolium, var. *Paradisi*, Besch. in Herb.

S. erythrocalyx Hpe. C. Müll. Synop. I, p. 92 (1849).

S. Peruvianum Mitt. in Musc. Austro-Amer. p. 625 (1869).

S. tursum C. Müll. Flora 1887, p. 410 (Brazil).

S. Hahnianum C. Müll. 1889, in litt. (Chili).

This species is diffused throughout the whole of America from Canada to Patagonia, and in numerous forms which have given rise to the proposing of many species. It seems, therefore, imperative in this place to subjoin a full description of S. medium.

Dioicous: male branchlets purple. Size and habit of S. cymbifolium, but with the tufts *variegated*, dappled with green and red to violet-purple, often only the male amentula faintly suffused with red; rarely pure green or white. Branches not more than four, of which two are spreading, strong thick-fusiform, horizontal or ascending, often curved, obtuse, more rarely short-pointed. Wood cylinder *purple or rose-red*, shining through the cortex. Stem cortex mostly composed of 4, rarely of 3 or 5, layers of cells, the superficial cells half as large as the others, scantily provided with weak fibrils or with none, and with 1 or 2 pores on the outside. Stem leaves as in S. cymbifolium, sometimes larger, sometimes smaller, spatulate; hyaline cells free from fibrils, or in the upper part fibrillose and on the outer side porose. Branch leaves variously shaped, sometimes densely sometimes loosely imbricated. Cortical cells of the spreading branches usually with fibrils, very rarely without; porestructure on both sides of the leaf similar to that of S. cymbifolium. Chlorophyllose cells in cross section small, *elliptical*,

central and completely enclosed on both sides by the biplane hyaline cells. In plants with loosely spreading leaves the chlorophyllose cells in the apical part of the leaf are free on both sides, although central. Inner walls of the hyaline cells, so far as they are united to the green cells, *smooth or papillose.* Upper perichætial leaves with a prolonged rounded point, in the upper half with fibrils and a few pores; above fimbriate all around. Spores 0.024 to 0.028 mm. diam. in mass rust-colored, minutely punctate.

In Rév. des Sphaignes, p. 5, Cardot pronounces *S. erythrocalyx* Hampe to be a form of *S. papillosum* Lindb., to which, however, the plant can not belong, by reason of the central, elliptical chlorophyllose cells, enclosed on both sides by the biplane hyaline cells, wherefore it must be reckoned among the forms of S. medium. In the European forms the cortical cells of the stem are always furnished with slightly developed, very slender fibrils, but in the tropical forms, such as S. erythrocalyx, S. Hahnianum, S. Peruvianum, etc., the fibrils are entirely wanting in the cells of the stem cortex; indeed, I have seen forms in which the formation of fibrils, even in the cortical cells of the stronger spreading branches, has nearly or wholly ceased, so that one finds distinctly developed fibrils in the cortical cells of the pendent branches only. Furthermore, all the known European forms of S. medium have smooth inner walls of the hyaline cells of the branch leaves, while tropical forms sometimes exhibit an abundance of well developed papillæ; this is, for example, the case in *S. erythrocalyx* Hpe. from Brazil. I have not yet met with forms in which the development of the papillæ has been very feeble, irregular, and therefore indistinct, but I do not for a moment doubt that they will yet be found in S. medium, as already they have been in S. cymbifolium. There may be distinguished, therefore, in S. medium, with respect to the development of the papillæ in the branch leaves, two principal series of forms: 1. var. *læve*, and 2. var. *papillosum;* in the former all the European and North American species will be counted, in the latter *S. erythrocalyx* Hampe.

Var. *læve* f. *purpurascens* (Russ.). Tufts, especially the heads, purple to violet-red, below pale or darker brownish, but not variegated with red and green.

N. H., Lisbon, 1,000 ft.; Mass., Boston and Dedham, 100 ft. (*Faxon*).

f. **versicolor** Warnst. Tufts, as to the heads, more or less red, below green, at the bottom yellowish or whitish, therefore of two or three colors.

N. H., Crawford's, 1,900 ft., Franconia, 1,000 ft.; Vermont, Lake Willoughby, 1,000 ft.; Mass., Brookline and Dedham, 100 ft. (*Faxon*).

f. **virescens** WARNST. Plants, in the upper part pale-, gray-' or dark-green, below brown or whitish.

N. H., Mt Washington, 5,000 ft., Crawford's, 1,900 ft.; Vt., Lake Willoughby, 1,000 ft.; Mass., Boston, 100 ft. (*Faxon*).

f. **fuscescens** WARNST. Plants above more or less browned, below bleached out or violet-brown.

Mass., Essex Co. (*Robinson*).

f. **albescens** WARNST. Tufts completely bleached, nearly throughout white. Here belongs *S. Hahnianum* C. Müller from S. America.

Having reached the conclusion of these statements, I can not refrain from earnestly entreating all American bryologists to collect the Sphagna of their respective neighborhoods systematically and more copiously than has, perhaps, heretofore been customary. In doing this, the common as well as the rarer forms should receive attention. Only by doing this can we expect that, in the course of time, more light may be shed on the geographical distribution of the different species and forms. I should, in such event, be cheerfully ready to investigate and report upon any small or large collections of Sphagna that might be sent to me. Small packages can best be sent by mail, at a very small expense of postage, marked "Samples without value." The packages must not exceed 8 inches long, 4 inches wide and 2 inches thick. Each specimen should be numbered, and it is allowable to attach a ticket to each, on which the locality should be noted. It will be all the more agreeable to me to receive such Sphagnum packages from many different regions, because I intend to elaborate the whole of the American Sphagna in a separate treatise.

I hope that this preliminary work may help to excite and heighten the interest in the difficult, indeed, but very remarkable family of the peat-mosses. To Mr. Faxon, who has had the kindness to translate this work into English, I here express my most sincere thanks. May he long continue to take, as heretofore, an active interest in sphagnology.

ADDENDUM.—*Sphagnum Lindbergii*. A weak, compact form of this species has been found in very wet, boggy soil on Mt. Monroe, N. H., alt. 4,200 feet.

The following corrections may also be noted:

p. 133, line 17 from top, for "cuticle" read *cortex*.

p. 138, last line, for "externally" read *extremely*.

p. 133, line 19 from bottom, for "acutifolium" read *acutiforme*.

p. 135, line 9 from bottom, for "ta.b." read *tab*.

p. 137, line 17 from bottom, insert a hyphen after *grayish*.

p. 189, line 15 from bottom, for "looser and" read *looser or*.

p. 218, line 14 from top, for "ranged" read *ringed*.

p. 223, line 14 from bottom, for "serrulatum" read *serrulata*.

p. 226, line 14 from bottom, for "specimens" read *a specimen*.

Neuruppin, Germany, Feb. 6, 1890.

Some recent observations on black-rot of the grape.

B. T. GALLOWAY.

During the summers of 1889 and 1890 we made a series of experiments, with a view of determining, if possible, the relationship existing between the so-called *Phyllosticta labruscæ* Thum., which occurs on the leaves of the cultivated and wild grapes, the *Phyllosticta ampelopsidis* E. & M., occurring on Ampelopsis quinquefolia and A. Vietchii, and the various forms attacking the fruit of the cultivated grape, which, as shown by Scribner and Viala[1], are stages of one fungus, namely *Lastadia Bidwellii*, of Viala and Ravaz.

Without going into details of the work, we will say that something like 200 inoculations of the berries of a dozen or more varieties of cultivated grapes were made from pycnidia-spores obtained from the leaves of Ampelopsis and Vitis; but in no case did we succeed in producing any of the Lastadia forms, or for that matter any disease whatever. Berries of all ages were used in the experiments; some were inoculated as they hung on the vines, and were protected from outside contamination by paper bags; others were brought into the laboratory, and, after being inoculated with germinating spores from the leaves, were placed in damp

[1]Black-rot. Bulletin No. 7. Section Vegetable Pathology, U. S. Department of Agriculture, 1888.

chambers and kept there for a week; a large number of clusters were brought into the laboratory, and, after being inoculated, were placed in the incubator, where a constant temperature of 32°C. prevailed. At the expiration of four days the berries in the incubator would usually turn brown, but microscopic examination revealed the fact that this was due to the attacks of moulds and bacteria.

In the majority of cases the inoculations were made by teasing up a bit of the affected leaf in water, and after making sure, by means of the microscope, that this water contained spores, it was allowed to stand from twenty-four to thirty-six hours, or until the spores had germinated. The water was then spread on the berries with a camels hair brush. In addition to this method, others, such as using spores fresh from the leaf, and spores sown in 3 per cent. solutions of grape sugar, were tried. Various degrees of light from absolute darkness to bright sunshine were also brought into play, all with the same result. To test the matter another way, sowings of pycnidia-spores from the berries were made on the leaves, the result being purely negative in every case. Pycnidia-spores from the berries were also sown on the berries, but in no case did we succeed in obtaining any definite results from this source.

The foregoing experiments were made in 1889. This season the same ground was gone over with practically the same results as those already noted. In addition, however, a series of inoculations were made with the ascospores of the Lastadia, and, as these yielded more definite results, we shall give an account of the work in full.

In the fall of 1889 a large quantity of berries which had succumbed to the attacks of black-rot a few months before were collected from the vines growing in the grounds of the United States Department of Agriculture. These berries were placed in a corner of my garden where they were left fully exposed to the weather until the middle of May of this year. Frequent microscopic examinations were made in the meantime for the purpose of determining the date of the first appearance of mature ascospores, which, we may as well add here, was the 15th of February. From this time on the ascospores were found in more or less abundance, the maximum number being reached about the middle of May, after which they began to be less numerous and finally disappeared altogether by the 20th of June. At no time were pycnidia-spores found in any of the berries.

Experiment No. 1.—On the 25th of April a potted plant of Ampelopsis quinquefolia, which had been in the green-house for four months, was removed to the open ground and planted on the spot where the diseased berries had lain all winter. The vine, which was about two feet long, was spread out on the ground and a large number of grapes containing ascospores were placed on the leaves. For the next twelve days there were frequent rains, which, with the warm weather prevailing at the time, afforded just the conditions necessary for the rapid development of the fungus. On the 10th of May a number of the Ampelopsis leaves showed the characteristic spots of the Phyllosticta, and an examination of these a few days later revealed the presence of pycnidia and pycnidia-spores. The spores and pycnidia did not differ in any respect from those formed in the usual way. Another plant of Ampelopsis quinquefolia about thirty feet distant from the first served as a control experiment. No spots appeared on this plant at all.

Experiment No. 2.—May 10 two pot grown plants of Norton's Virginia grape having four well formed leaves were planted in my garden and were immediately covered with bell jars. May 11 the bell jars were removed and about a handful of the old grapes containing ascospores were placed on the leaves, the jars being immediately replaced and not disturbed again for a month, except to water the plants, the latter being done every two days. At the expiration of twenty-five days both of the plants treated as above showed a number of leaf spots, which upon examination proved to be typical Phyllosticta discolorations bearing upon their surfaces pycnidia, which contained the usual shaped spores. A dozen potted grapes fifteen feet distant remained perfectly healthy throughout this period.

Experiment No. 3.—Two plants of Muscat of Alexandria grape growing in the green-house were covered with bell jars. On May 20 several bunches of diseased berries obtained from the same source as in the preceding experiments were placed on the leaves of each plant. In ten days Phyllosticta spots were showing on a number of the leaves, and five days later a number of the leaves were almost destroyed by the fungus. The leaves of the Muscat, being thin and tender, seem to succumb very readily to the disease, which instead of forming definite spots involves the whole leaf. All other vines in the same house remained healthy.

Experiment No. 4.—May 25 four leaves of a house grown

Muscat vine were inoculated with pycnidia-spores obtained from another house grown Muscat and immediately covered with a bell jar. The spores were obtained in the usual way by teasing up a bit of the affected leaf in distilled water. In ten days the inoculated leaves were all affected. The leaves of one of the control plants also showed the characteristic spots of the Phyllosticta, which fact throws a doubt on the whole experiment. Unfortunately, we were not able to repeat this trial, as no plants suitable for the purpose could be obtained.

Summing up briefly the positive results of these investigations, we have the following:

I. Two hundred or more inoculations of the grape berry with pycnidia-spores from the leaves of Vitis and Ampelopsis produced no effect whatever.

II. The same number of inoculations of the leaves of Vitis and Ampelopsis with pycnidia-spores from the berries of the grape gave the same results as I.

III. Fifty or more inoculations of the berries with pycnidia-spores from the berries yielded the same results as I and II.

IV. Inoculation of Ampelopsis leaves with ascospores from grape berries resulted in the formation of typical Phyllosticta ampelopsidis spots, pycnidia and spores at the expiration of fifteen days.

V. Inoculations of grape leaves with ascospores from the berry produced Phyllosticta labruscæ spots, pycnidia and spores in twenty-five days.

We have no reason to doubt the genuineness of the results obtained in the case of IV and V, first, because the old berries, so far as could be determined by microscopic examination, contained no other reproductive bodies but the ascospores, and, second, an examination of the water found on the leaves after a rain revealed only ascospores, and these in various stages of germination. So far as we know no other attempt of this kind has been made to establish the identity of the various forms here discussed, excepting that by Viala in France in 1888.[2] In May of that year, according to Viala's published statement, the ascospores of the black-rot fungus were sown on healthy grape leaves still on the vine. In from eight to twelve days the characteristic spots and pustules of the Phyllosticta appeared. Prof. Viala does not say how the inoculated leaves were protected from outside contamination,

[2] Comptes Rendus, June 18th, 1888, p. 1711, Recherches experimentales sur les maladies de la vigne.

nor does he mention any control plants used in the experiment.

If it is true, as the experiments here recorded would seem to indicate, that the ascospores are the main source of infection, and that the spores from the Phyllosticta forms on the leaves of Vitis and Ampelopsis will not grow on grape fruit, the matter is one of considerable practical importance. This part of the subject, however, we shall not touch upon here, our purpose being merely to record the facts, leaving the practical questions involved to be settled by field experiments, which we may add are now under way.

Department of Agriculture, Washington, D. C.

Notes on North American Umbelliferæ. II.

JOHN M. COULTER AND J. N. ROSE.

(WITH PLATE XV.)

The first paper of this series was published in this journal of November, 1889. The present paper consists chiefly of a report on Mr. J. Donnell Smith's Guatemalan collection.

HYDROCOTYLE LEUCOCEPHALA Cham. & Schl. No. 1776 of Smith from Coban Department, Alta Vera Paz, alt. 4,300 feet, April 1889; also 74 of Türckheim from near the same locality, May 1879. Although Mr. Hemsley says that he has found no publication of this species from Mexico, these specimens seem to accord very well with the description.

HYDROCOTYLE BONARIENSIS Lam., var. **Texana** n. var. Petioles and peduncles 15 to 20 cm. long; leaves orbicular-peltate, not notched at base, 12 to 15-nerved: inflorescence 5 to 10 cm. long, irregularly or 3 to 5-umbellately branched: pedicels 3 mm. long or less: fruit obtuse at base, 2 mm. long by 3 mm. broad.—Texas, 1888, *G. C. Nealley*. Probably collected along the sea-coast, as, otherwise, its occurrence within our borders would be hard to explain. The species is only known from southern Mexico and South America.

HYDROCOTYLE PROLIFERA Kell. This species is mentioned by Hemsley in Suppl. Biol. Cent. Amer., and to it are referred Coulter's, and Parry & Palmer's specimens, which in the body of the work are placed under H. interrupta. Smith collected it in Laguna Amatillan, Dept. Amatillan,

altitude 3,900 feet, March 1890; and here also is to be referred Türckheim 493, May 1879, from a marshy meadow near Coban; and very probably E. Kerbin's 482 in herb. Smith.

ERYNGIUM CARLINÆ Delar. Common in Guatemala. Smith 2199, altitude 5,000 feet. *E. Lemmoni* C. & R., of southern Arizona and northern Mexico, is very distinct from this and ought easily to be distinguished from it. E. Lemmoni lacks the central foliaceous bractlets of E. Carlinæ, and has different bracts and leaves which are also glaucous. To it should be referred Pringle 2010, of 1889, distributed as E. Carlinæ.

ERYNGIUM FŒTIDUM L. Esquintla, altitude 1,100 feet, March 1890, J. D. Smith.

ERYNGIUM PECTINATUM Presl. But two localities are given for this species by Hemsley in Biol. Centr. Amer., viz.: Sierra Madre (*Seeman*) and Tefie (*Lay*), neither of which collections we have seen. Smith's specimens are from San Raphael, Guatemala, altitude 6,500 feet, no. 2197. The species has never been very fully characterized, DeCandolle merely describing the leaves and involucre, the flowers being said to be unknown. The plant is tall and branching: leaves slender and long (35 to 45 cm.); bracts 2.5 to 3.5 cm. long, much longer than the globose head (12 mm. in diameter); bractlets lanceolate, cuspidately cleft, as long as the flowers or a little shorter: sepals broadly ovate, abruptly short-cuspidate, 1 mm. long: fruit 4 to 5 mm. long, the lateral scales forming a thin wing as broad as the body, the dorsal ones compressed: oil-tubes 5 (3 dorsal and 2 ventral). This plant differs from DeCandolle's description in the bracts being only occasionally squamose dentate at base. To this species we would also refer Gregg 637, collected in Mexico in 1848 and 1849, without flower or fruit; also Wheeler 192 from Orizaba, S. Mexico, collected in 1855, both in herb. Gray. We have also examined Bourgeau 1177, referred by Hemsley as "aff. E. pectinato." The leaves are very similar to those of E. pectinatum, having the same peculiar paired spines (but the longer are shorter than the breadth of the leaves). The heads are on shorter peduncles and are cylindrical cone-shaped instead of globose, 2.5 cm. long, longer than the (15) linear-lanceolate entire bracts; bractlets much larger than the flowers. Unless there is a mixture of specimens this form ought to be made distinct.

ARRACACIA BRANDEGEI Coulter & Rose has been again

collected by Mr. Brandegee in Lower California, at Todos Santos, June 28, 1890.

Arracacia Donnell-Smithii n. sp. Glabrous below, puberulent above, 15 to 18 dm. high: leaves (lower ones not seen) with long sheathing petioles, 2 or 3-ternate then pinnate: pinnate segments with 5 to 11 leaflets which are narrowly lanceolate, acuminate, sharply and finely serrate, 2.5 to 7.5 cm. long, lower surface puberulent to glabrate; petioles with a dense ring of soft hairs at base: peduncles 7.5 to 10 cm. long: rays puberulent, about equal, 3.5 to 5 cm. long: flowers white, with small calyx-teeth: fruit abundant, on pedicels 2 mm. long, ovate, glabrous, 6 mm. long, with small conical stylopodium. (Plate xv.)—Top of Volcan de Agua, Depart. Zacatepequez, Guatemala, April 1890, no. 2196. From the locality, here is to be referred Arracacia sp. no. 12 of Hemsley's list in Biol. Centr. Amer., specimens now in herb. Kew collected by Salvin and Godman. Mr. Smith makes the following note: "No. 2196 is a plant occupying in abundance the zone of Volcan de Agua from 10,000 to 11,000 feet, associated with another endemic and equally conspicuous plant, Lupinus flabellaris."

OTTOA ŒNANTHOIDES HBK. In a deep crater of Volcan de Agua, Depart. Zacatepequez, April 1890, altitude 12,000 feet, no. 2195. This species extends from S. Mexico to Peru. No specimens of this plant are in the National or Columbia College herbaria, and but a single one from Peru in herb. Gray. A good figure is found in HBK. Nov. Gen. et Sp. V. 423.

PEUCEDANUM AMBIGUUM Nutt. The stems are sometimes 37.5 cm. high, and mostly from small globose tubers covered with minute rootlets; in other cases the root elongated and moniliform: in the largest plants simply a long slender root The radical and lower leaves are simply ternate, with the leaflets 2.5 to 7.5 cm. long.

PEUCEDANUM LEIOCARPUM Nutt. proves to be a very poisonous plant.

Crawfordsville, Ind., and
Washington, D. C.

On the structure and development of the lemon.[1]

L. S. ROSS.

(WITH PLATE XVI.)

The mature lemon has its own characteristic lemon color; it is oval in outline and varies in size. The rind is rough, thick and leathery, and affords much protection to the seeds and pulp within. By looking closely at the rind, small dark specks may be seen which indicate the position of oil glands. If a piece of the peel be bent or crushed together suddenly near a flame, the oil will be forced out in minute quantities and will burn with a beautiful flame. If a cross section of the lemon be made, it will at once be seen that narrow white bands pass from the rind to a central spongy mass forming from seven or eight to eleven or twelve isosceles triangles whose apices are toward the center of the fruit. The white bands are the cut edges of walls extending through the entire length of the fruit dividing it into chambers or loculi which contain the seeds and pulp. Near the bases of the triangles their common walls divide, one division going to form the base of one triangle, while the other division passes in an opposite direction to form the base of the adjoining triangle. When a lemon or an orange is "quartered" the line of division begins at the angle where the wall between the loculi divides and passes along the center of the wall showing that it is double. The loculi are seen to be filled with the pulp mass which can be separated into many "clubs," some space is generally occupied by the seeds, but by far the greater part by the pulp. The pulp clubs have a very delicate straw color and are semi-transparent; their shape and size varies according to their position in the loculus. They are all attached to the back of the loculus, that is to the side of the loculus next the rind, hence those lying toward the center of the fruit are longer than those lying nearer the rind. The long clubs are usually symmetrical and consist of a tapering body with a long attenuated stalk for attachment. Those nearer the rind have shorter stalks. The clubs that come in contact with the seeds ac-

[1] The following notes give the results of studies on the lemon, *Citrus limonum L.*, carried on during the spring of 1890 in Professor Burrill's laboratory at the University of Illinois. The illustrations were made from nature by the author. I wish to express my thanks to Mr. C. W. Butler, of St. Petersburg, Fla., for his kindness in supplying me with specimens of young fruit.

quire any shape necessary to conform to the outline of the seed; also those near the extremities of the loculi are irregular in shape. On crushing the pulp the acid juice is forced out; and it will be noticed that the clubs near either extremity are sometimes harder than those nearer the center and do not contain as much juice. The cross section may lay bare the seeds growing from the inner angles of the loculi and imbedded among the pulp. Sometimes only abortive seeds are found, or sometimes abortive and developed. In the center of the section will be seen a white, spongy circular mass whose perimeter is formed by the lines of the inner rounded angles of the loculi. These lines are curved in such a way that their convexities are turned toward the center of the circle. Here the same division of the walls of the loculi will be noticed as at the back. By looking closely several spots may be discovered in the spongy center near the perimeter, one occuring at each angle formed by the curved lines of the perimeter.

The rind is of the lemon color about one-third of its thickness, the other two-thirds being white. The large, dark oil glands are quite conspicuous, extending even inside the yellow part into the white part of the rind. By looking carefully, many small, dark specks may be distinguished distributed through the white rind. One speck may be found at the center of the back of each loculus and also one in the angle at the juncture of any two loculi.

The cross section of the mature lemon presents a radial arrangement like the wheel of a wagon: the center spongy mass being the hub, the white part of the rind representing the felloes, the yellow part the tire, and the walls of the loculi the spokes, while the wheel is made solid by the filling of pulp clubs. For the illustration of the cross section of the mature lemon, see fig. 1.

In the very young lemon the style is the most prominent part: it is not much less in diameter than the ovary and is two or three times as long, with the upper end slightly enlarged. After the fruit has become about 4 or 5 mm. in diameter the style drops off and the fruit assumes the shape it retains through growth to maturity. The color is yet dark green, the lemon color not being attained until maturity. A cross section of a fruit 2 mm. in diameter shows the loculi already present, but without the pulp clubs. The rind and the walls of the loculi are relatively very much thicker and the solid center column much larger than in the mature fruit. At a

later stage the ovules are present in the loculi as club-shaped protuberances arising from their inner angles as represented in fig. 2. The loculi are relatively larger than in the younger stage.

If a microscopical examination of the cross section of the mature lemon be now made, the rind is seen to be made up of cells of various shapes and sizes. The epidermis is a thin layer in which the cells are thin-walled, empty and colorless: these cells are small in size and rectangular in shape. Next to the epidermis appears a layer of thin-walled palisade cells, thenfollow cells containing chromatophores, some partially filled, others full. The oil glands are located in the yellow part of the rind, some times extending into the white. They are large structures visible to the naked eye: their walls are composed of thin-walled rectangular cells so arranged as to give the glands a circular or oval shape when seen in outline. Inside the colored is the white portion of the rind, which is made up of loose spongy parenchyma with elongated cells. The small specks mentioned as being visible without the microscope will be seen to be fibro-vascular bundles, some of which are found to extend through the length of the lemon, while others form a net-work with the principal bundles and one another. A large bundle is seen at the center of the back of each loculus, and one also at the angle between any two loculi. The other smaller bundles are found sometimes with a rather regular arrangement, at others, apparently scattered promiscuously throughout the rind (see fig. 1). Some sections lay bare bundles lying at right angles with the long axis of the lemon. The specks noticed in the center column are seen to be fibro-vascular bundles also. The center column is composed of large-celled, spongy parenchyma. The dissepiments between the loculi are composed of spongy tissue with tougher thicker-walled tissue on either side. The pulp clubs are of a very delicate structure; the wall is composed of elongated narrow cells parallel with the long axis of the club (fig. 3). The inner part of the club is divided into large very thin-walled cells, which contain the juice (fig. 4). The tissue forming the wall of the club is an outgrowth from the thickened cells of the dissepiment walls, while the inner juice cells are a continuation from the spongy parenchyma at the back of the loculi.

Let us now turn to the development and inquire what are

all these structures and what is their derivation. It has long been known that flowers and fruits are produced from whorls of especially developed leaves. Let us compare a mature leaf with one of the loculi, and note the similarities (figs. 5 and 6). In the leaf a large midvein extends through the whole length, gradually tapering from the base toward the tip. A very small irregular marginal vein is seen, and a short space inward from the marginal vein and connected with it at various places, is a submarginal vein. A hand magnifier is needed to make out the marginal vein in the leaf. From the midvein other veins pass obliquely toward the margin; from these again minute branches pass off, forming a close network of veins. Now let us examine a loculus. Along the center of the back is a large fibro-vascular bundle slowly tapering toward the tips. With this bundle many others are connected, which form a network over the back of the loculus, similar to the network of veins on the back of the leaf. The meshes formed by the bundles are larger toward the base of the loculus than at and beyond the center. It will be seen in a side view of a loculus (fig. 7) that a large bundle passing along its inner angle through the center column curves about the end of the loculus and passes back along the upper lateral angle to the end from which it started. This is the bundle previously mentioned in the description of the cross section as being seen at the angle between any two loculi. The only way in which I can account for this fibro-vascular bundle and its peculiar shape, is that it is formed by the marginal and submarginal veins of the leaf. As has already been noticed, there are several points of connection between these veins so that by the development of the vein connecting them, at or below the place where the style drops off, the required curve is made and the bundle receives its shape. One fact favoring this supposition is that the pulp clubs are not attached to the side walls but to the back of the loculus. The great development of the space between the marginal and submarginal veins of the leaf necessary to form the side of the loculus would not be favorable to the development of the leaf hairs of that region. Another favorable fact is that a longitudinal section of a fruit before the pistil has fallen, if made at the right place, shows the bundle already curved about the loculus at a very short distance from the pistil. The fibro-vascular bundles in the rind at right angles with the large mid bundles probably represent small veins passing from the larger veins to the surface of the leaf.

The bundles appear when the fruit is first formed, and change their relative position somewhat as development progresses. The loculi vary in number in different lemons: some specimens having seven or eight and others as many as eleven or twelve. Each loculus represents a carpellary leaf. The leaf is folded with the upper surface inward toward the axis. The margins are again folded where they meet and project a short distance away from the axis about which the carpellary leaves are gathered. These infolded margins form the placentæ upon which the ovules are borne. The ovules appear at a very early stage of development. The nucleus is first seen toward the top, but it afterwards grows towards the base. Two rows are in each loculus, one upon either margin of the carpellary leaf. Often only one ovule develops, sometimes neither; for this cause the number of seeds in different specimens varies much. In a young fruit, 4 mm. in diameter, the ovules are quite large, having two walls enclosing a nucleus. Fig. 8 shows a cross section of a loculus with both ovules developing; the section is such that the ovules are cut near the upper part, exposing the nuclei of the young seeds. The spongy center column forming the axis of the lemon is a development from the infolded margins of the leaf. The pulp clubs are derived from the leaf hairs, and first appear as blunt protuberances from the back wall of the loculus. They gradually enlarge and elongate until they fill up the space of the loculus crowding about the seeds and lying close upon one another, but not structurely united.

From all this we see that every part of the fruit has its origin from some part of the leaf.

A cross section through a pistil shows a set of fibro-vascular bundles in a circle about half way between the center and the perimeter. The bundles are of a complicated structure, being divided by rows of small empty cells. Toward the upper end of the pistil only one circle of bundles appears: farther down another circle makes its appearance nearer the perimeter of the section. The inner circle seems to continue through the length of the pistil into the fruit. Another section through a pistil shows very broad narrow bundles, the breadth of a bundle being about one-half the radius of the pistil.

A section through the upper end of a lemon one-half inch in diameter shows the fibro-vascular bundles as narrow bands surrounded by regular rows of cells, the row next the dense

center being filled with a granular substance (fig. 9). Around this row are one or two regular rows of thick-walled cells and others irregularly arranged. Near the perimeter of the section are the oil glands formed by regular rows of rather narrow, elongated, rectangular cells; and about these are irregularly arranged cells. Next the perimeter the cells are small, but the size increases further inward to the fibro-vascular bundles, between which, and in the center column, the cells are smaller.

A section through the same specimen at the beginning of the loculi shows some small fibro-vascular bundles surrounded by very small, empty, thin-walled cells. The bundles in the center column are broad and narrow, but further into the interior of the fruit they become rounded and smaller. The oil glands are well developed.

EXPLANATION OF PLATE XVI.—Fig. 1. Cross section of mature lemon, showing half the section; *a*, yellow part of rind; *b*, white part of rind; *c*, loculus filled with pulp; *d*, spongy center column; *e*, double wall of the loculi; *f* and *g*, fibro-vascular bundles. Fig 2. Cross section of young fruit 3.5 mm. in diam.; *a*, loculus; *b*, ovule; *c*, center column; *d*, fibro-vascular bundle; *e*, oil gland; *d'*, fibro vascular bundles of rind; *f*, rind, Fig. 3. Cells of wall of pulp club. Fig. 4. Cells containing juice in the pulp clubs. Fig. 5. Leaf; *a*, midvein; *b*, smaller veins; *c*, marginal vein; *c'*, submarginal vein. Fig. 6. Back of loculus; *a*, large fibro vascular bundle; *b*, smaller bundles forming a network. Fig. 7. Side view of loculus; *a*, *a*, curved fibro-vascular bundle; *b*, back of loculus; *c*, minute bundles seen in side wall of loculus. Fig. 8. Loculus showing both ovules developing, the section being such that the nuclei are exposed; *a*, loculus; *b*, nucleus of seed; *c*, inner wall about nucleus; *c'*, outer wall of ovule; *a'*, ovule. Fig 9. Section through upper end of lemon ½ in. in diam.; *a*, epidermis; *b*, cells about oil gland *c*; *d*, cells of rind; *e*, dense center of fibro-vascular bundle; *f*, cells about center.

Champaign, Ill.

EDITORIAL.

THE APPEARANCE of Dr. Merriam's report of a biological survey of the San Francisco mountain region of Arizona (noticed elsewhere in this number) suggests a timely topic for botanists to consider. This same subject was prominently before the botanists of the American Association at their Indianapolis meeting, in considering the geographical distribution of North American plants. The notion that a plant is only valuable because it is a new or rare species, and that it makes no special difference as to its exact locality, its soil conditions, or its altitude, is one that should

be remanded to the limbo of unscientific methods. The problem that is now presenting itself to North American workers in systematic botany lies behind all systematic botany, and considers geographical distribution. But no study of this subject can be made at long range or by the most persistent study of the disjointed facts at our command.

It is time that botanists bestir themselves in the matter and consider the organization of a regular biological survey, that will deal with plants as biological problems and not merely as specimens to be catalogued. The money which is now expended for botanical exploration could be made to serve handsomely in starting such a systematic survey. It is no special credit to American botany that a zoologist who is working in this systematic fashion can find no help from botanists, but is compelled to combine a botanical survey with his own. Not that the two departments should be worked separately, for a biological survey must include both, but the point is made that botanists should do their share. Dr. Merriam is to be thanked for his example, and he would only feel that it was facilitating his work if botanical explorations could be converted into biological surveys.

BRIEFER ARTICLES.

The translation of Hackel's "True Grasses."—This work received a notice in your journal for August, by Mr. Theo. Holm. As to the translation I have no doubt that it is faithfully executed, and that it is accurate, clear and scientifically correct. For students of grasses this work must possess great interest and value. The illustrations are excellent and will be a great aid to the understanding of the technical descriptions. While this work can not, perhaps, be excelled as a synopsis of all known genera of grasses, it may be a question whether a reduction and modification of it adapted to the United States or to North America would not be more generally useful in this country. Of 313 genera described, there are in this country, of native and introduced ones, only about 120 genera. The work of local students in identifying a grass would be much reduced if they only had occasion to take into view the genera proper to this country. True, the general range of each genus is stated, and the student can, when investigating a species, leave out of view those whose range is beyond the limits of our country. But there are some omissions in regard to range, etc., in consequence of which the student might fail to find what he wanted. I will refer to a few instances: on page 53, under the genus Rottboellia, sub genus 1, it is said, "species twenty in the tropics of both hemispheres." Our species might be overlooked from this statement, one ranging as far north as Delaware, and another as far as eastern Arkansas. On the same page under the subgenus Hemarthria nothing is said of its extension to Texas, where the species *fasciculata* is abundant in some localities.

In the genus Andropogon are included, as sections or subgenera, some grasses which have been known as genera, and here some confusion may arise for the student—on page 61 the subgenus Chrysopogon does not, as might be supposed, include our species known as Chrysopogon nutans and C. secundum, these being by Mr. Hackel placed in the subgenus Sorghum although they are not specifically mentioned. The *Sorghum secundum* Chap. is called by Mr. Hackel in his monograph of Andropogoneæ, page 533, Andropogon unilaterale—the name secundum being appropriated by the *A. secundus* Willd., now, however, made a synonym of *A. contortus* Linn. Again on page 63, under subgenus Heteropogon, there are "5 species in the tropics, one of which is cosmopolitan as far north as South Europe and North America." No mention is here made of the *Andropogon melanocarpus* Ell. (*Heteropogon acuminatus* Trin.) which is found as far north as North Carolina. This omission is not, however, a fault of the translators, but might have been corrected by a note. On page 74, under Eriochloa it is said, "five species, in the tropical and subtropical zones of both hemispheres." Two or three at least of the species extend into the temperate zone, one as far as southern Kansas. On page 110, of the genus Thurberia it is said "species two, Arkansas and Texas." The range should be extended to Florida, and I think there is but one species. The genus Calamagrostis is here made to include Deyeuxia as a section, but the section *Calamovilfa* Gray, is raised to generic rank. Some botanists will prefer to retain it as placed by Dr. Gray, and to add to it a third Floridan species *C. Curtisii* Vasey (published as *Ammophila Curtisii* Vasey.)

These instances do not materially detract from the high value of the work, but are referred to to indicate a few points in which some additional editorial notes would have been an improvement.

The remarks made in the volume, respecting the habits and economic and medicinal uses of certain grasses, are of great interest and value. Those respecting the different varieties of the cultivated Sorghum (*Andropogon arundinaceus* Scop.) are especially interesting, although many will prefer to keep *A. halapensis* Sibth. as a distinct species. The notes on Saccharum, on sections Eupanicum, Setaria and Pennisetum are also interesting. The adoption of the genus Zizaniopsis for *Zizania miliacea* Michx. will be acceptable to botanists. The species seems to be rare in the northern states, although it is recorded in Gray's Manual from Ohio and doubtfully from Penn. The notes relating to the history of our cultivated cereals are very valuable.—GEO. VASEY, *Washington, D. C.*

Pithecolobium Texense Coulter.—In studying the material of Nealley's Texan collection (Contr. Nat. Herb. 2. 37) I was forced into Pithecolobium by indisputable floral characters, at the same time recognizing the exact similarity in every other respect to what has been called *Acacia flexicaulis* from the same region. Strangely enough, the status of

Bentham's A. flexicaulis was not questioned. It is now found, however, that flowering specimens collected by Gregg, evidently our Pithecolobium, were named Acacia flexicaulis by Bentham, certainly without a careful examination of the flowers; and that the original specimens of Berlandier, from Tamaulipas, were flowerless. It seems safe to conclude that all that has ordinarily been called Acacia flexicaulis must be referred to Pithecolobium Texense; and its recent discovery by Dr. Palmer at La Paz extends its range through Southern Texas and Northern Mexico to the western side of the continent. In the absence of flowering specimens from Berlandier's locality it is hardly safe to conclude that Bentham's original A. flexicaulis of necessity must be our Pithecolobium. If this can be proved, the long known specific name could well replace the newer and our plant be known as P. flexicaule. It is more prudent, however, to consider that Bentham's original A. flexicaulis possibly may prove to be an Acacia after all, and to leave it a name and place.

JOHN M. COULTER.

CURRENT LITERATURE.

A biological survey.

THE *North American Fauna*, No. 3, published by the Division of Ornithology and Mammalogy of the Department of Agriculture, contains a matter of very great interest to botanists. Dr. C. Hart Merriam, the chief of the Division, has felt the necessity of putting the biological exploration of the country upon a thoroughly scientific basis. The patchy collecting and inaccurate noting of localities, which has largely obtained in our exploring expeditions, may be conceded to a vast *terra incognita* such as our western botanists first encountered; but no such concession should be made now, and "collecting trips" should be transformed into "biological surveys." Dr. Merriam has begun the good work by a careful study of the very interesting San Francisco Mountain Region of Arizona, and although his chief concern lay with vertebrate animals, his zones of distribution were necessarily marked out by plant growth, and his results are not only of great botanical interest, but are far more valuable in that they mark out a line of botanical work which the government should at once enter upon and push to its completion. The paper before us not only deals with the biological features of the San Francisco Mountain region, but is also a valuable contribution to the general subject of geographical distribution. This paper should be read by every botanist, and we only append a statement of the most important general results as given by the author: (1) The discovery that there are but two primary life areas in N. Am., a northern (boreal) and a southern (subtropical), both extending completely across the continent and sending off long interpenetrating arms; (2) The consequent abandonment of the three life

areas commonly accepted by naturalists, viz.: the Eastern, Central, and Western Provinces; (3) The recognition of seven minor life zones in the San Francisco Mountain region, four of boreal origin, and three of subtropical or mixed origin; (4) The correlation of the four boreal zones with corresponding zones in the north and east. Colored maps are used to indicate distribution, and the one of most general interest is a provisional biological map of North America.

Watson's Contributions.

In looking over the bulky contributions to American botany which issue every year from Cambridge and other botanical centers in this country, it seems that, "of making species there is no end." But so long as new species are found they must be described, and the fascination which attends their discovery will always push this kind of work in a most unflagging way. The "Contribution" before us is Dr. Watson's 17th in this form, appearing in Proc. Am. Acad. xxv. pp. 123–163, and is about as "solid botany" as it could be made, nothing of the list character appearing. The first part consists of miscellaneous notes, many of them being the formal presentation of the reasons for adopting certain changes in the new edition of Gray's Manual. As these changes are already indicated in the Manual, it is not necessary to recount them here. The recognition of 4 new species of Streptanthus gives occasion for a synoptical key to all the species, numbering now 22. One of the notable things is the establishment of the genus *Eriogynia*, occasioned by the discovery of a very peculiar Montana species, which also takes with it two species heretofore placed under Spiræa, as fully presented and illustrated in the present number of this journal.

The second part is chiefly concerned with Mr. Pringle's Mexican collections of 1888 and 1889, which, as usual, abound in new species. An enumeration of these 88 new species, or any part of them, is impossible in our limited space, but the new genera are important enough to be specially mentioned. *Sargentia* is a new genus of *Rutaceæ*, a tree, and fitly commemorates Professor C. S. Sargent. *Rhodosciadium*, a new genus of Peucedanoid *Umbelliferæ*, has double signification in the color of its flowers and the name of Mr. J. N. Rose, whose long association with the writer in the study of N. Am. Umbelliferæ this genus deservedly commemorates. *Jaliscoa* is the third new genus, belonging to the *Eupatoriaceæ*.

The "nerves" of the sensitive plant.

IN THIS pamphlet Dr. G. Haberlandt describes what has been a hitherto unobserved system of tissues, to which he gives the untranslatable name of "reizleitende Gewebesystem," by means of which the impulses set up by a stimulus of any sort are propagated in the sensitive plant.

[1] HABERLANDT, G.—Das reizleitende Gewebesystem der Sinnpflanze. 8vo. pp. 87, pl. 3. Leipzig: Wilhelm Englemann. 1890. Mk. 4.

One of the tissues in question is located in the sieve portion of the vascular bundles of the stem, the pulvini, the petioles and the veins. The cells which compose it are very like the sieve cells, but larger, with more or less oblique end walls on which is a single large pit whose closing membrane is traversed by numerous protoplasmic threads. The contents of these cells seems to be a glucoside or some similar body. A nucleus is always present. Another part of the system consists of the sensitive parenchyma of the pulvinus, which is in connection with the collenchyma which surrounds the vascular bundle. There is no direct protoplasmic connection between the protoplasts of the collenchyma and those of the conducting tissue of the bundle.

In the latter part of the work the author discusses the physiology of the sensitive tissue at length. So close and continuous is his discussion that it is not possible to summarize it satisfactorily. While there are still obscure points and some things "hard to be understood," the theory is certainly more satisfactory and open to fewer objections than the present ones.

The name of the publisher, Engelmann, is sufficient guarantee of the excellence of the typography and beauty of the plates.

Cretaceous plants.[2]

The author presents here a preliminary report upon a collection of fossil plants made by himself and Prof. Lester F. Ward at Martha's Vineyard during the summer 1889. The age of the formation in which these fossils occurred has finally been stated to be Cretaceous, and probably Middle-Cretaceous. Seven or eight species are enumerated and figured, concerning the identification of which a few remarks may be made. As to the figured leaves of Liriodendron, it is rather doubtful whether they belong to this genus or not. They agree quite well with figures of similar leaves supposed to belong to this genus, given by other authors, but it seems to have been overlooked that this form of leaf is more characteristic of quite different genera, as for instance Eucalyptus, of which several species show the same shape of leaves. They have been found together with some remains of undoubted Eucalyptus, and this circumstance seems to speak in favor of the supposition that they should belong to this genus. The author has, however, figured a leaf (fig. 8 on the plate) which he has ideptified as Eucalyptus, but it is very poorly preserved, so that the identification is not without question. When the author calls fruit of Eucalyptus "a nut," it is to be pointed out that the fruit of this genus is a capsule, and it is not easy to understand what the author means by his expression "nut with operculum" in the explanation of the plate. These figured remains, supposed to belong to Eucalyptus, are not "fruits," but flowerbuds. It is a well-known fact that the calyx in several genera of the Myrtaceæ is coherent at the apex, and that it falls off

[2] DAVID WHITE.—On Cretaceous Plants from Martha's Vineyard, with one plate. (From American Journal of Science, Vol. XXXIX, 1890.)

like a cap before anthesis, and the author ought to have read the description of similar remains given by Heer in his "Flora fossilis arctica," Vol. VI, pars II, p. 19, where he says: "Ein becherförmiges Körperchen, das lebhaft an die Blüthenknospen von Eucalyptus erinnert." The figured leaves of Andromeda and Myrsine are so defective that their identification seems rather hazardous.—THEO. HOLM.

Minor Notices.

THE APPEARANCE of Part II of Farlow and Seymour's provisional host-index of the fungi of the United States will be warmly welcomed by the large and ever increasing number of students in this field of botany. This part includes the Gamopetalæ and Apetalæ, and the remainder of the work is promised in November, for which third part botanists are urgently requested to report errors or omissions in the parts already issued. The value and accuracy of the work need no commendation when one remembers the unrivaled facilities at the command of the authors. A glance through the well-printed pages also demonstrates the appalling amount of synonymy that a mycologist is compelled to face.

DR. CHAS. E. FAIRMAN has issued a paper on the fungi of western New York, being the first of a set of contributions to the mycology of that region that the author proposes to issue. He has been collecting for several years in Orleans county, and has collected over 425 species. The present paper gives a general discussion of the fungi of his region, and lists 30 species (with two plates) as representing the new species and varieties which he has added to the mycologic flora of western New York.

AN INTERESTING paper on the "History of Botany," read by Dr. T. J. W. Burgess before the Hamilton Association of Canada, has been printed in pamphlet form.

DR. N. L. BRITTON has laid botanists under obligation to him by preparing so complete a list of state and local floras of the U. S. and Brit. Amer. as the one just issued as "Contributions from the Herbarium of Columbia College, no. 14." So many of these lists are empheral or buried out of sight that it is a great boon to have them all together in one handy pamphlet.

MR. THEODORE HOLM, of the U. S. National Museum, has published an interesting paper on "The leaves of Liriodendron," appearing in the Proc. U. S. Nat. Museum. The great variability of the leaves of Liriodendron is well known, but Mr. Holm detects a certain regularity in the midst of all this variation, dependent upon position. He discusses the subject fully, with the help of 6 excellent plates, in the preparation of which the author is a master, and then applies his results in the consideration of fossil forms. It is just such studies that must be of immense service to paleobotany.

THE REPORT of the chief of the section of vegetable pathology for

1889 not only shows most commendable industry, but also contains valuable material. The report discusses the publications and correspondence of the Section (now Division); its field work, consisting of the treatment of grape diseases and those of the apple, pear and quince, treatment of blackberry rust, of the potato, tomato and melon for blight and rot, and of strawberry leaf-blight; conclusions concerning the practical work of the Section; laboratory investigations; investigation of peach yellows, by Dr. Erwin F. Smith and Prof. T. J. Burrill; the California vine disease, studied by Mr. Galloway himself in a most painstaking way, as we happen to know; and a mignonette disease, described and most handsomely illustrated by Mr. D. G. Fairchild.

THE REPORT of the chief of the Forestry Division for 1889 contains a great amount of information that has been collected from all quarters. The topics treated are as follows: Forest economy, forest technology, forest biology, irrigation, seed and seedling distribution, timber culture act, osier culture, forestry interests in the U. S., export and import statistics, proposed work, and influence of forests on water supplies. The last named topic is the prominent one, and will repay careful reading.

THE REPORT of the botanist of the Nebraska State Board of Agriculture for 1889 is a valuable document, as might be expected when it is known that the botanist is Dr. Charles E. Bessey. The first part of this pamphlet of 162 pages is a report on the grasses and forage plants. This is Dr. Bessey's work, assisted, of course, by his associates. The second part is a catalogue of the plants of Nebraska, by Mr. H. J. Webber, a most welcome addition to our list of state floras, and one which would have materially helped the Manuals if it had been published sooner. Some 1,872 species and 730 genera are enumerated, but the list begins with Phytomyxa and ends with Vernonia. Although botanical interest should concern itself chiefly in learning what plants grow in Nebraska, botanical attention will largely be given to the sequence of the groups. Dr. Bessey's well known opinion that one should begin at the beginning, has here a chance to express itself, and so, as the pages are turned over, one finds himself climbing up the ladder instead of backing down. When Phanerogams are reached (Anthophyta, they are called), Luerssen's arrangement of families is followed, but a good index enables a botanist to find his way. The fact is, it is a good plan to "try on" the various proposed arrangements in this way and see how they fit. Any new arrangement looks outlandish at first, but that is no argument against it. The summary of groups is as follows: 39 Protophytes, 95 Zygophytes, 20 Oophytes, 691 Carpophytes, 47 Bryophytes, 17 Pteridophytes and 981 Anthophytes.

THE SECOND part of "West American Oaks" has been published, containing 13 full-page plates, which are a decided advance upon those of the first part. The prefatory note briefly expresses the relation of this part to the first somewhat as follows: Upon the publication of the first

part, Mr. James M. McDonald (to whose generosity the whole work is due) was impressed with the necessity of further examination of the new species and varieties mentioned therein. These had not been known to Dr. Kellogg. Accordingly, Professor Greene volunteered to give his summer vacation to field work in the Sierra Nevada and in the Rocky Mountains of Colorado and Montana. The present part contains the results of these fresh investigations.

THE SIXTH fascicle of Castillo's "Illustrationes floræ insularum maris Pacifici" has appeared, a most elaborate work. The present fascicle contains no plates, but those that have appeared are of exquisite workmanship. Accompanying this part is a pamphlet by the same author, discussing the flora of Polynesia and its relation to that of neighboring countries.

THE FOREST FLORA of New Zealand has been admirably illustrated and described in a recent work by Mr. T. Kirk.[3] It was prepared and published by the direction of the colonial government, and is a monument to the liberality and wisdom of the government, and to the scientific and economic knowledge of the author. The large plates are admirably drawn, and are accompanied by from 2 to 5 pages of text, giving a technical and popular description of the species. Much attention has been given to the economic importance and the best ways of utilizing the different woods, and also to the proper use of common names for distinguishing the various kinds.

THE FIRST volume of the *Muscologia Gallica*[4] is now complete by the issue of the ninth part, including the last of the Acrocarpi. The subscribers receive at the same time a reprint of the first ten plates, which were badly printed when issued. The title page and preface are accompanied by an analytic key to the genera included in the volume. The second volume, embracing the Pleurocarpi, will be completed in five parts.

DR. JULIUS RÖLL, in a paper on the Acutifolium group of the Sphagna (published in the Botanisches Centralblatt—nos. 21–25, 1890—also reprinted), makes a strong, and in some parts almost a savage attack upon Warnstorf's work of this title which appeared some time ago. Without attempting to judge the cause at all we greatly deprecate such criticism, which only produces or intensifies hard feeling.

ANOTHER PAPER on the Sphagna is by C. Jensen, who describes the Danish species in the volume of memoirs published by the Botanical Society of Copenhagen in celebration of its semi-centennial. The Latin phrase *tot homines, quot sententiæ* is certainly true of the sphagnologists. Every writer has his own set of species which he recognizes, and he calmly relegates the others to the list of synonyms. Each "raiseth up

[3] Kirk, T. The forest flora of New Zealand. Imp. 8°. Wellington, 1889. pp. 345, pl. 142.

[4] HUSNOT, TH.—Muscologia Gallica. livr. ix, 8 vo. pp. i-viii and 257-784, pl. 69-79. The author: Cahan par Athis, Orne, France. 1890. fr. 5.—Vol. 1, fr. 45.

one and putteth down another" in truly regal style, until the amateur can hardly tell whether his plant should be called a species, a sub-species, a variety, a sub-variety, a form or a sub-form. However he will be helped to know what this writer means by the six plates of details which accompany the monograph.

OPEN LETTERS.

In reference to "biology."

[The following has been received from a "prominent zoologist."]

So there is trouble in the botanical camp. The wicked zoologists have been taking more than their share and a "prominent botanist" accuses them in the September GAZETTE of lack of philological lore, of common honesty or of even worse crimes. He even insinuates that zoologists are ashamed of the word zoology. All because they claim to teach biology. My memory is not very long, but it runneth back to a time when the boot was on the other leg. Then biology was never heard of. Instead we had the college curricula with their natural history courses, composed solely of botany and geology. There was indeed the college museum with its leather sided animals and its rows of impaled flies and other winged tortures, but aside from this the existence of the animal kingdom was not recognized within college walls except in the Sunday dinner at the college boarding house. I repeat, biology was then unknown—not only the name but the very thing itself. Was aught of *βιον* seen when reading those dismal and dreary papers constituting a Glossary of Botanical Terms? Did the student learn anything about *life* while trying to separate *Thalictrum* from *Anemone* or trying to unravel the snarl of the Asters and Solidagos? I ween not. Life and biology—a discourse on life—made its first appearance in the minds of the students when zoology lebowed its way into the curriculum. It was not until the living Amœba (the animal is not a myth) thrust out its pseudopodia right in the very face of the student, not until the action of the frog's heart was studied by every pupil, that biology came in. Zoology brought the impetus and the idea and in many a college where the botanist still goes his weary round of finding out whether the *ovule is orthotropous* or *anatropous* and of looking at the placentation of the ovule, all study of *life* is still left to the zoologist. Why should not he claim the word biology?

Protective resemblance in Cassia.

I am in a sandy region abounding in Cassia Chamæcrista and C. nictitans. Did any body ever notice the protective resemblance of the pods to the *closed* leaves? It is especially marked in C. nictitans. Here the leaves when blown by the wind, or touched, close the leaflets upon the rhachis, and then appress the entire leaf upon the main plant axis. The pods, with their lomentaceous tendency, bear a striking resemblance to these closed leaves, and are similarly appressed. In C. Chamæcrista they are divergent, as also, to a degree, are the leaves. Often I have been at first deceived, as to the fruiting condition of these pretty plants. Again, a yellow spider on C. Chamæcrista is amusingly like the flower.

Bultonwoods, R. I. W. W. BAILEY.

Poisoning by Euphorbia marginata.

In addition to the notes already published on this plant in the GAZETTE, page 225, 1887, I can now add the following: It is annually becoming more abundant, and is now a common weed about the streets of Mt. Carmel. For several years I had been seeing, as I thought, an unusually large number of cases of "ivy poisoning."

It so happened that in handling some fresh plants of this species, I accidentally rubbed a considerable quantity of the milky juice on my neck and under the collar. This produced a decided burning sensation during the afternoon, and the next morning I found the skin, as far as the juice had gone, red and thickly studded with a pimply eruption, which subsided in the course of several days by the use of a lotion of sugar of lead and laudanum. I then suspected that here was an explanation of my frequent cases of ivy poisoning, and further observation has proved this to be true.

Its gaudy appearance makes this plant very attractive; children in their plays, and others in collecting bouquets, pluck and handle it frequently. In many persons the juice produces a severe irritation of the skin, resulting in a thick fine eruption of a purplish-red color, presenting very nearly the same appearance as a case of poisoning by Rhus Toxicodendron, except that the eruption is a little finer in the former. I have seen a few cases, in children with unusually delicate skin, where the epidermis was raised, and the whole surface, as far as the juice had gone, was blistered. There is usually much complaint of a burning sensation in the parts affected.

Mt. Carmel, Ill. JACOB SCHNECK.

NOTES AND NEWS

GERMANY has now nine schools of forestry.

MR. F. W. ANDERSON has accepted the position of assistant editor of the *American Agriculturist.*

MR. J. G. BAKER, in *Journal of Botany* (Sept.), describes 18 new species of Tonquin ferns, collected by M. B. Balansa.

THE SHOOTS of a Bamboo in the Peradenya Botanic Garden, Ceylon, are reported to have grown at the rate of 13 inches in 24 hours in April.

The *Orchard and Garden* for August contains a portrait and biographical sketch of Professor F. Lamson-Scribner, Director of the Agricultural Experiment Station of Tennessee.

H. M. DEWEY, a graduate of Michigan Agricultural College, and for two years one of Dr. Beal's assistants, has been appointed one of the assistants in the Botanical Division of the Agricultural Department.

MR. CARL W. HARTMANN, of Sweden, is the botanist of the Lumholtz Mexican Exploring Expedition, which started from Arizona on August 30th, and hopes to return in the autumn of 1892.—*Garden and Forest.*

EUCALYPTUS seems to be sustaining its reputation as a "fever-tree." It is said to have made the Pontine marshes of Italy habitable, and it is now proposed to cultivate it on a large scale in the malarious parts of tropical Africa.

THE PLANTS recently illustrated in *Garden and Forest* are *Prunus Allegheniensis* Porter (Sept. 3), a monstrous form of *Kalmia latifolia* L. (Sept. 17), *Cornus Baileyi* Coulter & Evans (Sept. 24), and *Rosa Watsoniana* Crepin (Oct. 1).

PROFESSOR BASTIN, of Chicago, author of a well known botanical textbook, is much interested, according to the *American Florist*, in a project to make a wild garden of native plants a feature of the horticultural display at the World's Columbian Exposition.

THE THIRD ISSUE (Nos. 3-4) of the Bulletin from the laboratories of natural history of the Univ. of Iowa continues the enumeration of the saprophytic fungi of Iowa by Prof. T. H. McBride, and has a short account of the common species of edible fungi.

MR. T. V. MUNSON, a well known authority on grape vines, has given a conspectus of the American species of Vitis in the *Garden and Forest* (Oct. 1), with remarks upon their horticultural value. He enumerates 25 species, the distinctions between many of them having been discovered by cultivation.

THE TARIFF BILL, just passed Congress, contains a provision of much interest to every college teacher. It permits universities, colleges, etc., not only to import books for the institution free of duty, but also for any teacher connected with the institution. All works in languages other than English have been placed upon the free list.

WILLIAM RUSSELL, studying in the botanical laboratory of the Sorbonne, concludes that the tannin in Papilionaceæ behaves as a material for excretion, which localizes itself at first in special cells analogous to the latex vessels. These cells appear in the vascular bundles before the differentiation into wood and bast.—Cf. *Rev. gén. de botanique*, ii. 344.

EMANATING from the same laboratory and appearing in the same journal, are a series of papers by Aug. Daguillon on the leaves of Conifers. The writer shows that in the Abietineæ there are always what he calls "primordial" leaves, which are intermediate between the cotyledons and the permanent leaves. The transition from one sort to the other may be abrupt as in the genus Pinus or gadual as in Abies. The passage into the permanent form is characterized by a modification in the phyllotaxy, a change in the character of the epidermis, the development of one or more layers of hypodermal sclerenchyma (except in Cedrus, in which they appear even in cotyledons) and by alterations in the tissues of the vascular bundle and the parenchyma.

THE FUNGOUS DISEASES of spinach observed in New Jersey have been described and well illustrated in bulletin No. 70 of the N. J. Exper. Station, by Dr. B. D. Halsted. Mildew, anthracnose, leaf blight, white smut and black mold are mentioned. The anthracnose (*Colletotrichum spinaceæ* Ell. & Hals.) and white smut (*Entyloma Ellisii* Hals.) are newly discovered.

M. A. COGNIAUX has described a new southwestern genus of Cucurbitaceæ. *Brandegea* commemorates Mr. T. S. Brandegee who is doing much service in elucidating the botany of Lower California. The genus is near Cyclanthera, and contains two species, B. Bigelovii, which had already been doubtfully referred to several genera, and B. monosperma, the Cyclanthera monosperma of Brandegee. The distributed description is an extract from Proc. Calif. Acad. Ser. 2, iii, pp. 58-60.

RESEARCHES relating to the smut of cereals have been for some time and are still being carried on by Professor Kellerman and Mr. Swingle, of the Kansas Agricultural College and Experiment Station. A preliminary report on smut in oats (14 pp. and 4 pl.) was printed in Oct., 1889, and a more extended report on loose smut of cereals in Jan., 1890 (76 pp. and 9 pl.). These contain much excellent scientific matter. A third report will be issued probably before this number of the GAZETTE appears, and still another is partly ready.

IN THE REPORT of the Department of Botany of the British Museum for 1889, by Professor Carruthers, are the following items of general interest: During the year 51,652 specimens have been mounted, chiefly European plants, although containing collections from Singapore, China, Japan, Borneo, Atlas Mountains, Scotra, Madagascar, South Africa, Australia, Canada, Mexico, Dominica, and Republic of Columbia. One of the notable additions to the Herbarium is the acquisition by purchase of the microscopic preparations of Professor de Bary in connection with his investigations into plant anatomy and the parasitic diseases of plants. The total number of these slides is 4,429.

L. KNY thinks that much of the confusion as to the character of the pith rays of trees is due to the fact that the two elements have not been before distinguished. This he does in a communication to the German Botanical Society (*Berichte*, viii. 176). These two elements he designates as the "palisade" and the "merenchyma." The two are distinct (1) in form, the first being usually longer longitudinally than radially, while the latter are much elongated radially; (2) in the pitting of the wall in the neighborhood of the vessel, the palisade cells having wide pits while they are wanting entirely in the merenchyma; and (3) in the presence of small intercellular spaces between the cells of the merenchyma.

DR. B. D. HALSTED has collected an interesting set of facts as to the botanical work at experiment stations, and gives some of them in *Garden and Forest* (Sept. 24). There are now 29 botanists employed at these stations, and to the question "What botanical problems appear to you to be of most immediate importance in your state?" 16 reply "fungous diseases of cultivated plants." The study of grasses and forage plants is considered next in importance; next, the subject of weeds; then forest and forest-trees; and then plants for barren lands. Very few are working in the subject of fertilization; two are considering the relations of climate to vegetation; two are testing seeds; and at least one botanist considers bacteria among the more important subjects for study.

G. KRABBE takes issue with the long-accepted theory of Nägeli as to the mode of solution of starch grains by diastase, according to which the diastase was supposed to penetrate the grain and leach out, as it were, the molecules of starch as it converted them into glucose. The investigations of Krabbe show that diastase is probably a colloidal body, and unlikely to be able to penetrate starch grains, since it is unable to pass through parchment paper, clay cups or the cell walls of fir wood. The diastase in the form in which it can transform starch is not able to travel from one cell to another, and it is probably formed in the place in which it is to be used. In general, the solution of a starch grain is essentially like that of a crystal.—Cf. *Pringsheim's Jahrbücher*, xxi. 520.

NEARLY two and a half years ago the trunk of a Yucca, probably Y. elata, was received at Kew from Dr. Pringle as a specimen for the Museum of Woods. It measured 14 feet in height by 1 foot in diameter near the base. There was not a vestige of a root upon it, and the top had been sawn off. It was at once placed in the museum, where, of course, the conditions are almost as dry as an oven. A week or two ago two shoots were seen growing out from the top of the trunk, one composed of leaves, the other of flowers. On examination the whole of the trunk proved to be full of sap, and as succulent as if it had only just been dug up from the ground. It was, therefore, removed to the Temperate-house, where it may now be seen in flower.—W. Watson in *Gardener's Chronicle*.

THE INTERESTING method of research on the water conducting tissue devised by Bokorny (iron sulphate solution) has already been described

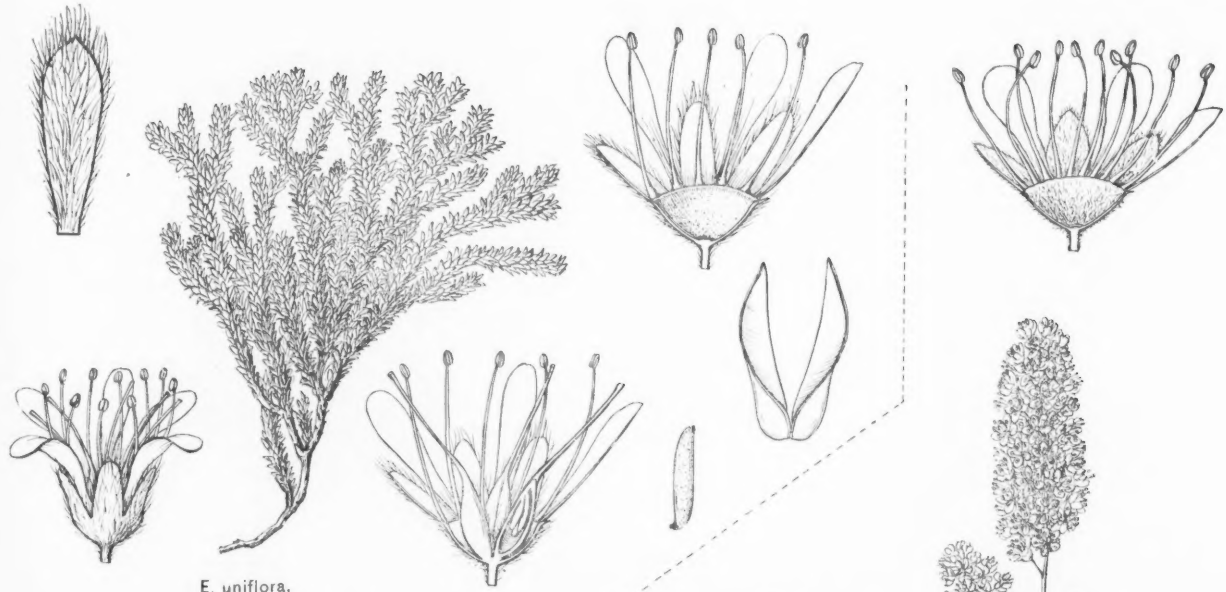
in this journal (xiv. p. 272). A further contribution to the same subject by Bokorny will be found in Pringsheim's *Jahrbücher* xxi. 469. Here the author discusses the relative conducting capacity of different tissues, the variation in this capacity induced by the action of various substances, the relation of the walls of vessels to conduction and the use of coloring matters for studying the transpiration stream.

THE BULLETIN of the Torrey Botanical Club for August contains "a descriptive list of the genus Heuchera," by Wm. E. Wheelock, in which 21 species are enumerated, H. Nova-Mexicana being a new one; a biographical sketch of Dr. Geo. Thurber, by H. H. Rusby; another installment of Dr. Rusby's South American plants, containing descriptions of 5 new species and completing the enumeration through Samydaceæ; a new Cheilanthes from Lower California, by D. C. Eaton, named C. Brandegei; and a new fern for N. Am., *Asplenium fontanum* Bernh. (*A. Halleri* R. Br.), reported by Professor T. C. Porter from both Pennsylvania and Ohio.

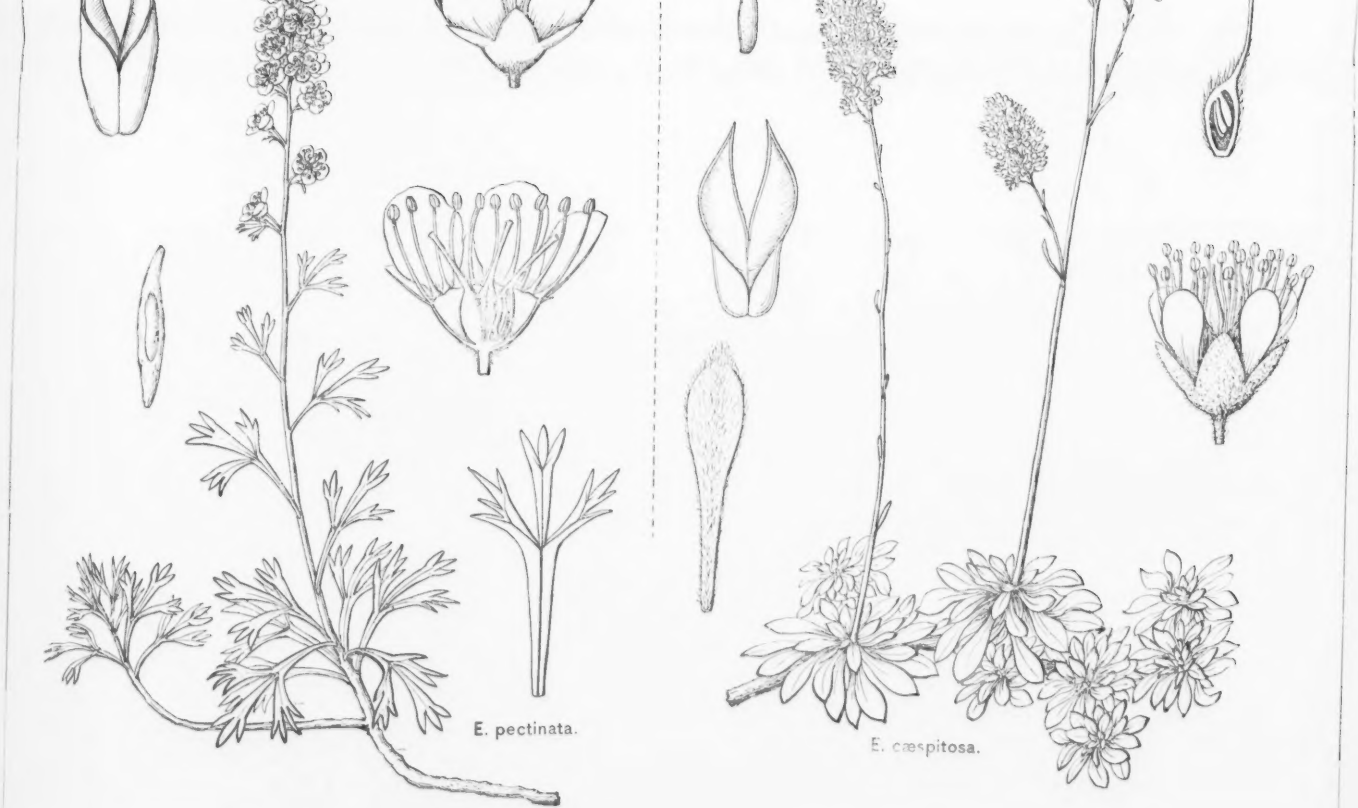
DR. ALFRED FISCHER has in the last part of Pringsheim's *Jahrbücher* a long paper on certain points in the physiology of woody plants. We translate a part of his summary of results as being of unusual interest:

In summer there may be obtained in the vessels of fifty per cent. of the deciduous trees examined and in the tracheides of the observed Coniferæ a very strong glucose reaction. The other fifty per cent. contain only a little glucose. Juglans and Fraxinus contain none. The glucose is generally only in the vessels, none or a very little being found in the wood fibers. Undershrubs and herbs contain no glucose in the vessels of their stems, roots, petioles, or veins. It does not occur in the two latter places even in the deciduous trees. In winter the amount of glucose in the glucose-poor woods remains small; in the glucose-rich woods there is a greater or less diminution in the amount present. In spring agreat increase in the amount of glucose in the vessels takes place during the time of blooming, which is followed by a further increase when at the beginning of May the reserve starch is dissolved; at this time the quantity reaches its maximum. There is no further increase of the glucose during the summer, but a slight decrease toward the end of the time of solation of the reserve food.

The starch in the body of a tree undergoes numerous changes, mostly during the period of vegetative rest. Eight phases may be noted: a starch maximum in late autumn, followed by a solution of starch in November; a starch minimum during December, January and February; a regeneration of starch in early spring, resulting in a starch maximum in spring; a solution of starch about the beginning of May, followed by a minimum towards the end of May; and finally, an accumulation of starch through the summer. In the hard wood trees the reserve starch of the wood and pith remains unchanged throughout the winter, only the starch in the bark being dissolved and appearing again in spring. In the soft wood trees, including the Conifers, the alterations in winter and spring affect all the starch in the pith, wood and bark. At the time of the winter minimum branches, pieces of bark and even microscopic sections will form starch in the cells in a short time, the more and the quicker the higher the temperature. Even at 5° C. starch will be formed in forty-eight hours. The material from which it is formed is glucose, which is already present in the cells. This starch regeneration in spring, as well as the solution of it in the autumn, is not entirely dependent on temperature, but is determined also by an inherited periodicity of the protoplasm.



E. uniflora.

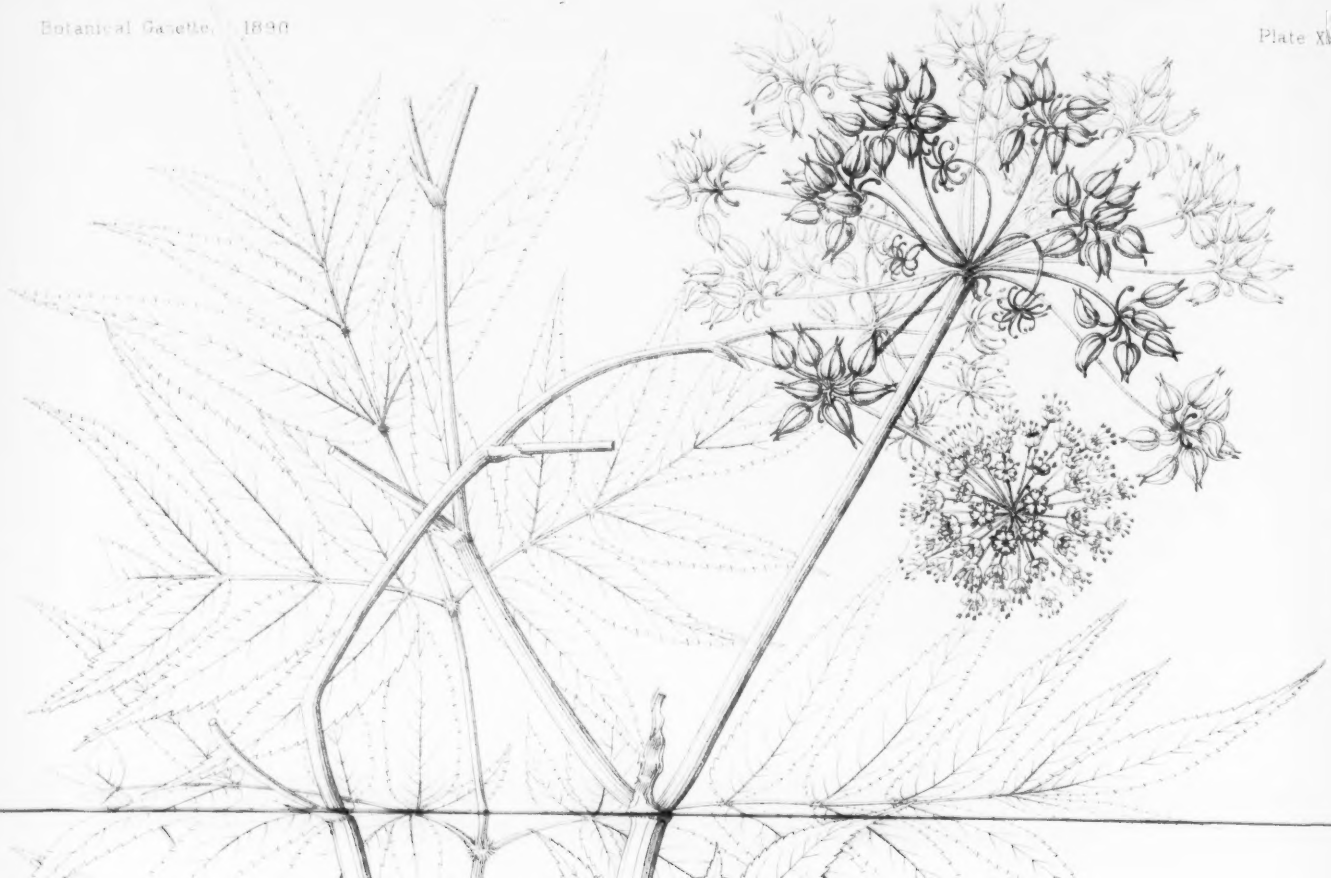


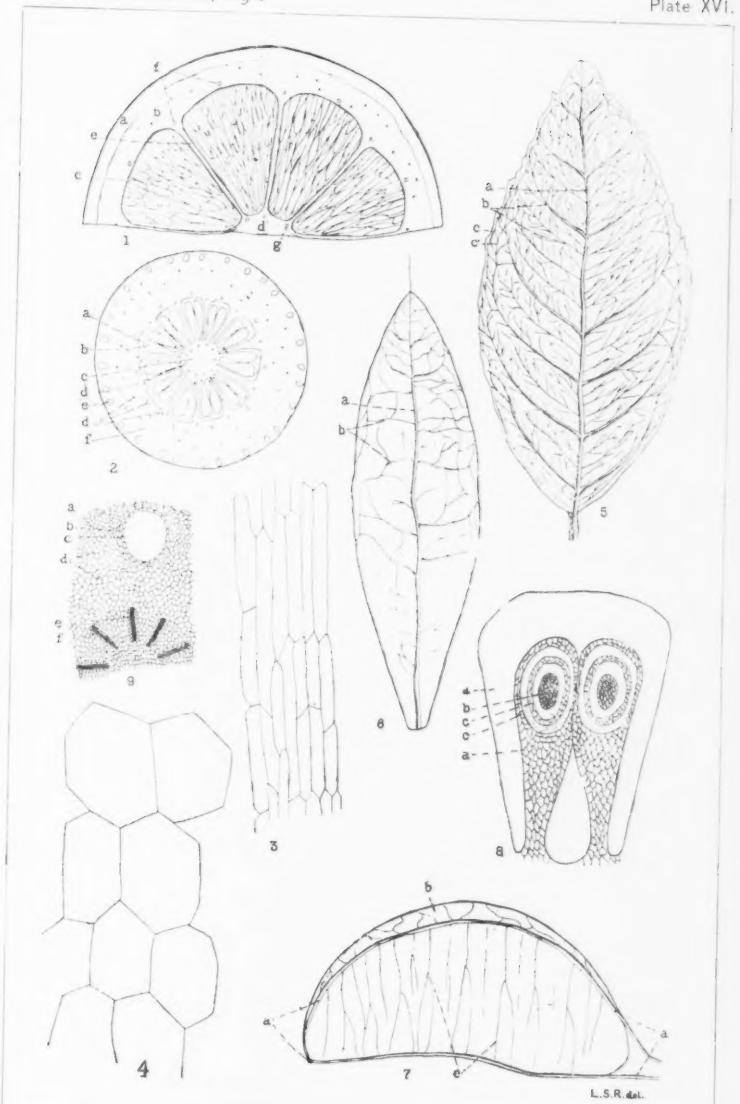
WATSON ON ERIOGYNIA.

C.E. Faxon, del.

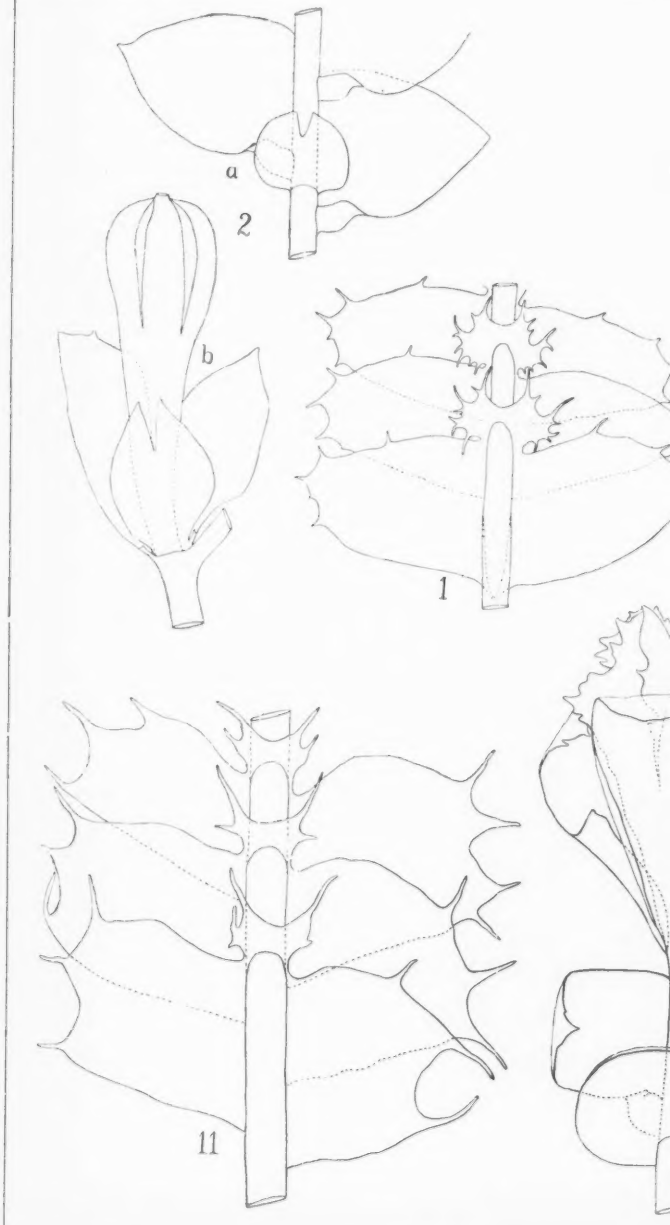
ARRACACIA DONNELL-SMITHII. Coulter & Rose. n. sp.

B. Meisel, Lith. Boston





ROSS ON STRUCTURE OF LEMON.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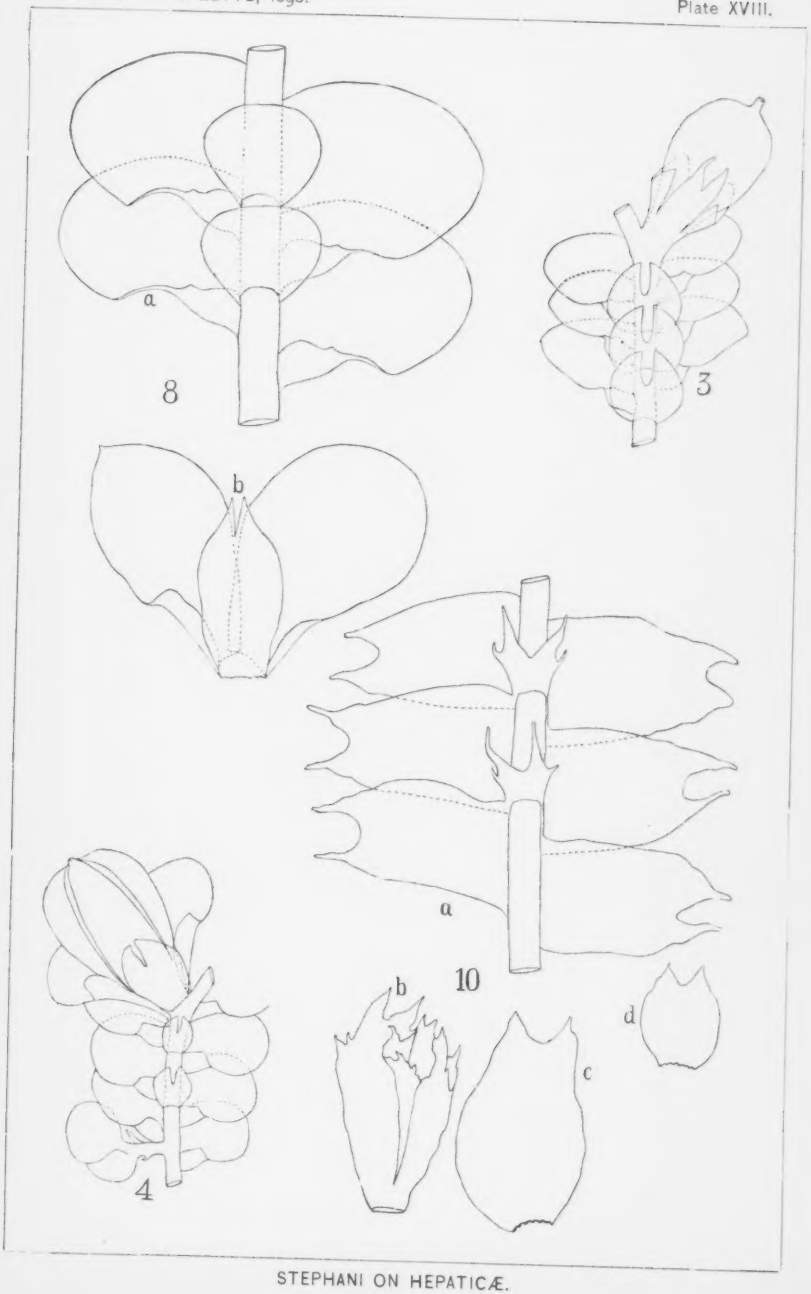
STEPHANI ON HEPATICÆ.



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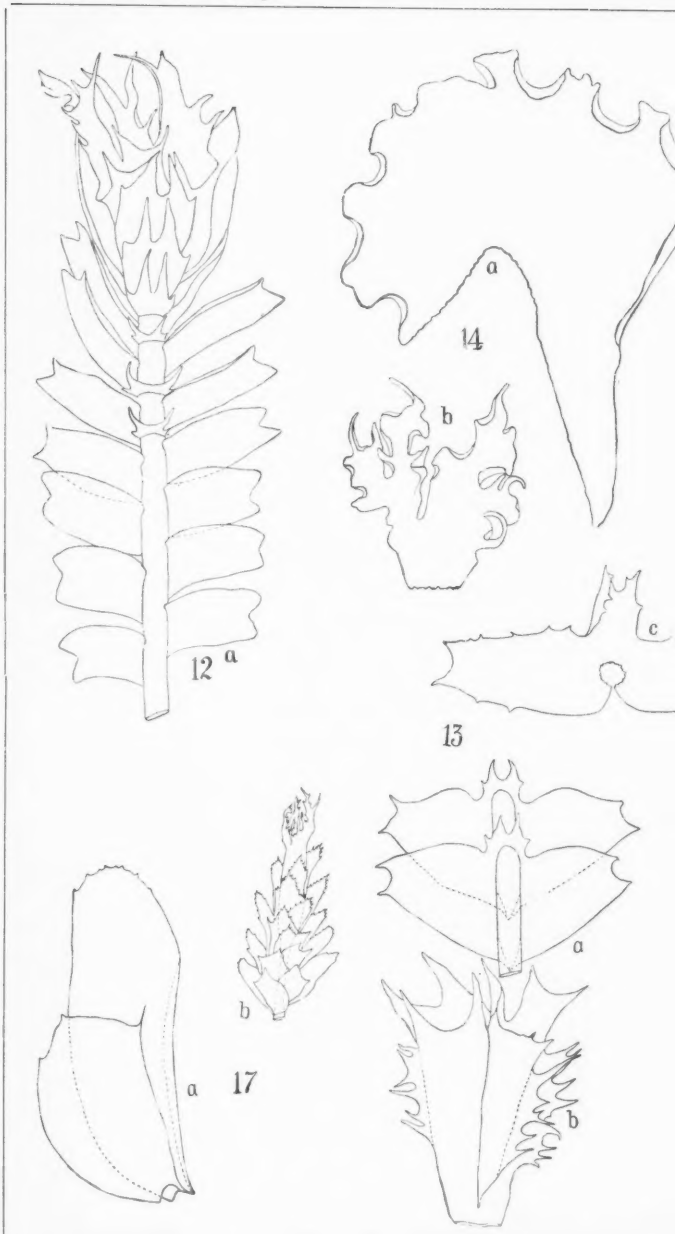
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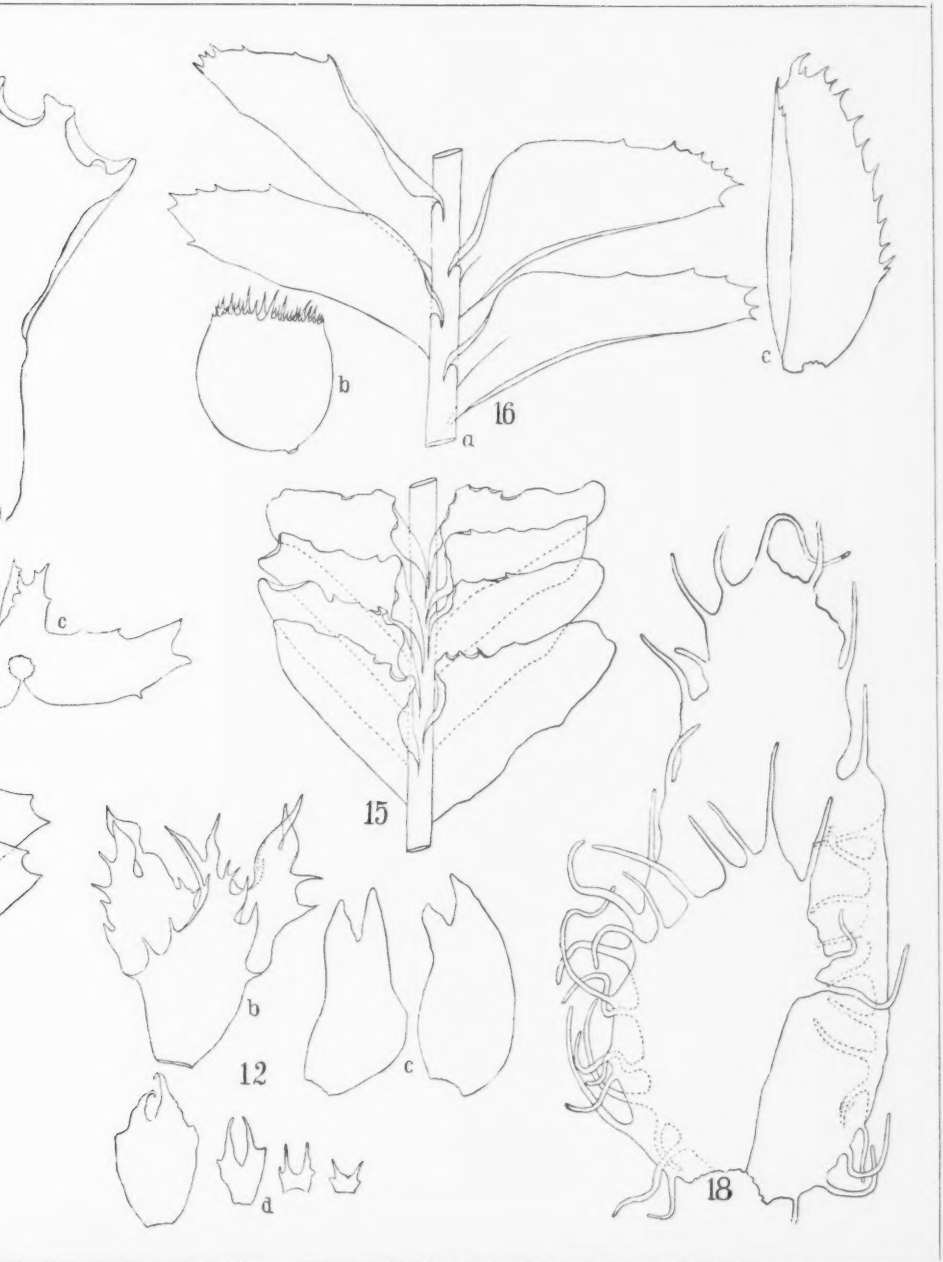

STEPHANI ON HEPATICÆ.